DOCUMENT RESUME

ED 256 727 SP 025 949

TITLE Boating the Right Way.
INSTITUTION California State Dept. of Education, Sacramento.
PUB DATE 85
NOTE 130p.
AVAILABLE FROM Publications Sales, California State Department of Education, P.O. Box 271, Sacramento, CA 95802-0271 ($4.00).
PUB TYPE Guides - Non-Classroom Use (055)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Adult Education; *Boat Operators; First Aid; *Maritime Education; Navigation; Recreational Activities; *Safety; Sailing
IDENTIFIERS Boats

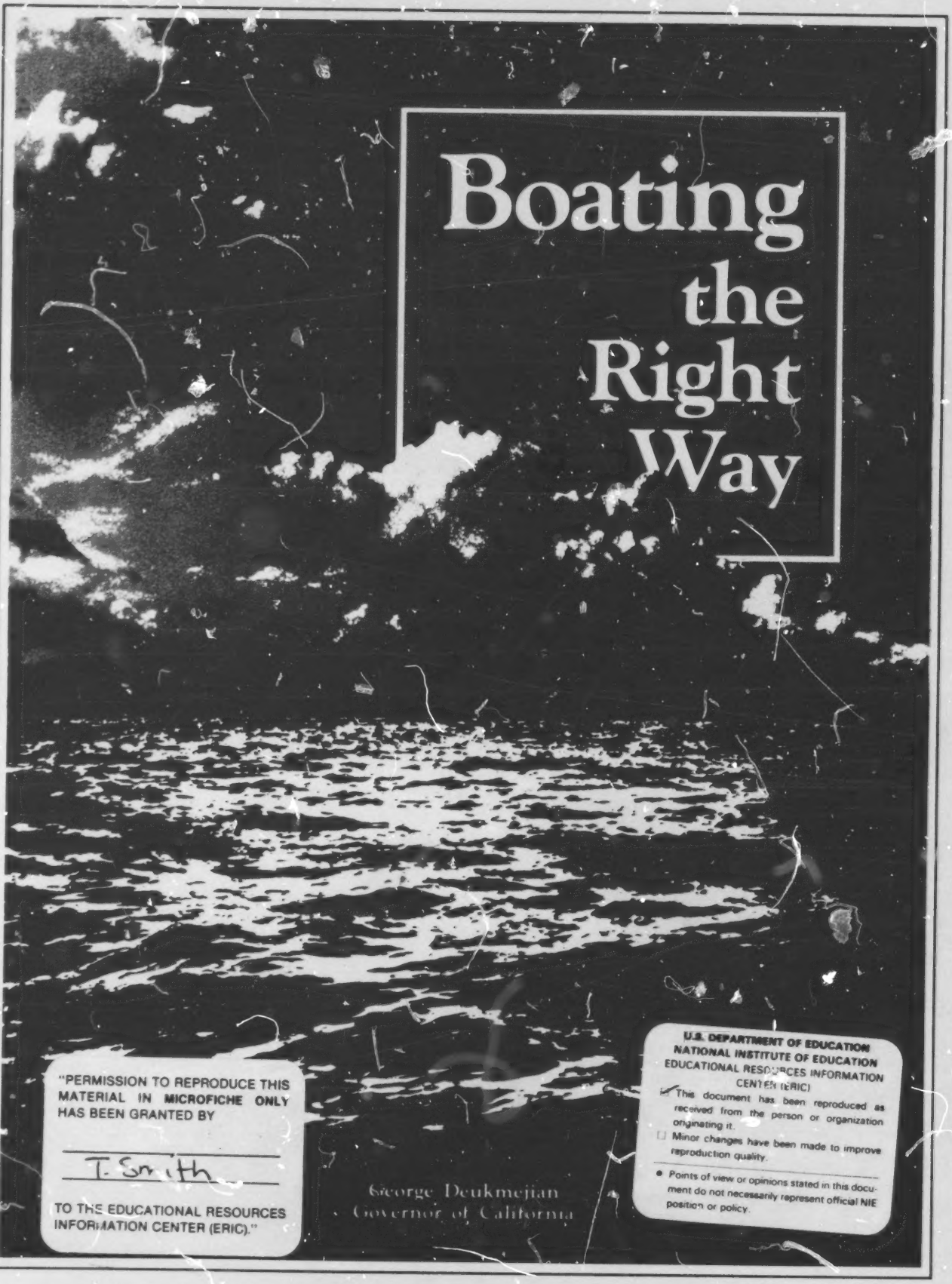
ABSTRACT

This monograph is a multipurpose resource document developed to meet the needs of young adults seeking boating knowledge, and to serve as a guide to the safe operation of watercraft. Chapter one deals with types of watercraft and the responsibilities of the boater. In chapter two, the water environment is discussed, including the water cycle, currents and tides, weather, and darkness and unfamiliar waters. The third chapter is devoted to equipment needed for safe boating. Techniques for handling different types of boats are discussed in the fourth chapter. Chapter five consists mainly of a study guide in the form of a self-test based on information contained in the booklet, "ABCs of the California Boating Law." A copy of the booklet is included with this publication. In chapter six, heavy weather and emergency procedures are discussed. The final chapter deals with first aid procedures for accident victims, heat sickness, and hypothermia. A glossary of terms and selected references are included. (JD)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED256727

Boating the Right Way



George Deukmejian
Governor of California

"PERMISSION TO REPRODUCE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

T. Smith

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

CS212359449

L
S
A
NL
70 P

Boating the Right Way

Prepared by
California State Department of Boating and Waterways
William H. Ivers, Director
in cooperation with the
California State Department of Education
Bill Honig, Superintendent of Public Instruction

George Deukmejian
Governor of California

Gordon K. Van Vleck
Secretary for Resources

Publishing Information

Boating the Right Way was a joint project of the California State Department of Boating and Waterways and the California State Department of Education. The work was based on a manuscript submitted by William Monti, Chairman, Physical Education Department, San Rafael High School. Editorial services were provided by Arthur Brown, former Editorial Assistant, Bureau of Publications. The layout and artwork were prepared by Norman Wobschall of the Bureau of Publications, with photographs by Carol L. Wheeler of Media Services. The document was prepared for photo-offset production by the Bureau of Publications, with typesetting by Anna Boyd and Lea Shimabukuro. It was published by the California State Department of Education, 721 Capitol Mall, Sacramento, CA 95814-4785; printed by the Office of State Printing; and distributed in accordance with the provisions of the Library Distribution Act and *Government Code* Section 11096.

Copyright, 1985
California State Department of Education

Copies of this publication are available for $4.00 each, plus sales tax for California residents, from Publications Sales, California State Department of Education, P.O. Box 271, Sacramento, CA 95802-0271.

A list of other publications available from the Department may be found on page 89.

Contents

	Page
Preface	v
Acknowledgments	vi
Chapter One: Introduction	1
Types of Watercraft	1
Responsibilities of the Boater	3
Chapter Two: Understanding the Water Environment	6
The Water Cycle	6
Currents and Tides	7
Weather	9
Darkness and Unfamiliar Waters	15
Chapter Three: Equipment for Safe Boating	16
Required Equipment	16
Additional Equipment	21
Chapter Four: Using Your Boat	36
Boat Handling Techniques	36
Canoeing	40
Rowing	44
Powerboating	48
Waterskiing	56
Sailing	58
Sailboarding	66
Chapter Five: Rules for Safe Boating	68
The California Boating Law	68
Navigational Aids	69
Importance of Filing a Float Plan	71
Study Guide	71

Chapter Six: Heavy Weather and Emergency Procedures 76
Heavy Weather 76
Emergency Procedures 77
Fires and Explosions 80
Falls Overboard 80
Collisions and Groundings 81

Chapter Seven: First Aid 82
First Aid for Accident Victims 82
First Aid for Heat Sickness 86
First Aid for Hypothermia 86

Glossary 87

Selected References 90

Preface

Recreational boating has increased significantly in the last decade; and as the waterways have become more crowded, the need for boating education has also increased, particularly among young persons who are new to boating. Lessons in boating safety learned early carry over into later life and thus have both an immediate and a long-term effect in reducing boating accidents. *Boating the Right Way* is a multipurpose resource document that was developed to meet the needs of young adults in their quest for boating knowledge and to serve as a guide to the safe operation of watercraft. Curriculum areas in which the book can be effectively used include physical education, health and safety, outdoor education, marine science, oceanography, and wherever an instructional program involves boating or the water environment. Depending on the needs of the program, the material in the book can be converted into specific lessons or used as a reading and vocabulary enrichment tool.

A part of the boating curriculum that often gives students trouble is boating laws and rules of the road. A novel approach to these subjects is taken in Chapter Five of this book, which consists mainly of a study guide in the form of a self-test based on information contained in the Department of Boating and Waterways booklet *ABCs of the California Boating Law*. A copy of the booklet is included in the pocket inside the back cover of this book.

Boating the Right Way can be augmented and reinforced in many ways by the teacher, parents, and community organizations that have an interest in promoting water safety. For example, the document may be used in conjunction with an available audiovisual package that complements and adds realism to the subject matter. The package consists of the following filmstrips and accompanying cassettes: *Good Seamanship—a Preface to Fun*; *A Margin of Safety—the Rules of the Road*; and *Live and Learn—Water-Oriented First Aid*. (See the reference *Boating the Right Way* filmstrip/cassette package in the selected references section of this book.)

Acknowledgments

The California State Department of Boating and Waterways and the California State Department of Education gratefully acknowledge the assistance given by the following organizations in the preparation of *Boating the Right Way*:

American Red Cross
American White-Water Affiliation
Latitude 38 magazine, Richard Spindler, editor and publisher
Maryland State Department of Education
United States Coast Guard
United States Coast Guard Auxiliary
United States Lifesaving Association
United States Power Squadrons

Chapter One

Introduction

California's friendly climate and plentiful rivers, lakes, and coastal waters have made boating one of the most popular forms of recreation in the state. During most weeks throughout the year, thousands of boat owners and their friends venture out in a mixed fleet of pleasure craft to enjoy a wide variety of water-based recreational activities. A day on the water with a sailboat, a motorboat, or a canoe can be a wonderful source of pleasure and relaxation, but the fun can suddenly turn to panic and perhaps disaster for those who do not know and follow the rules of safe boating. This book provides basic information that will help the beginning boater acquire the knowledge and skills he or she must have to operate watercraft in a responsible, safe, and enjoyable manner.

Types of Watercraft

Boats and other watercraft may be classified according to their normal means of propulsion, which may be manual power, wind power, or mechanical power. Rowboats, canoes, kayaks, small inflatables, and floating surfboards are examples of manually powered watercraft. Sailboats and sailboards are wind powered. The mechanically powered category includes all watercraft that are propelled by one or more inboard or outboard motors.

Watercraft in one category may share some of the characteristics of those in another category. For example, a motor sailer is a motorboat equipped with auxiliary sails that are smaller than those normally found on a sailboat of comparable size. The sails may be used to provide all or some of the motor sailer's power in favorable winds, and they steady the vessel in heavy seas. On the other hand, most sailboats are equipped with a small auxiliary outboard or inboard motor that enables them to make headway when becalmed and to maneuver in close quarters, as in docking. And a rowboat or even a canoe can be converted to a powerboat through attachment of a small outboard motor.

BEST COPY AVAILABLE

Manually Powered Watercraft

Manually powered watercraft have many attractive features: their initial cost and maintenance costs are relatively low, and they cost practically nothing to operate; they are easy to transport and store; and they can be used in many places that are not accessible to larger craft or where power boats are not permitted, as in certain restricted wilderness areas. Some types of manually powered watercraft are shown in Fig. 1-1.

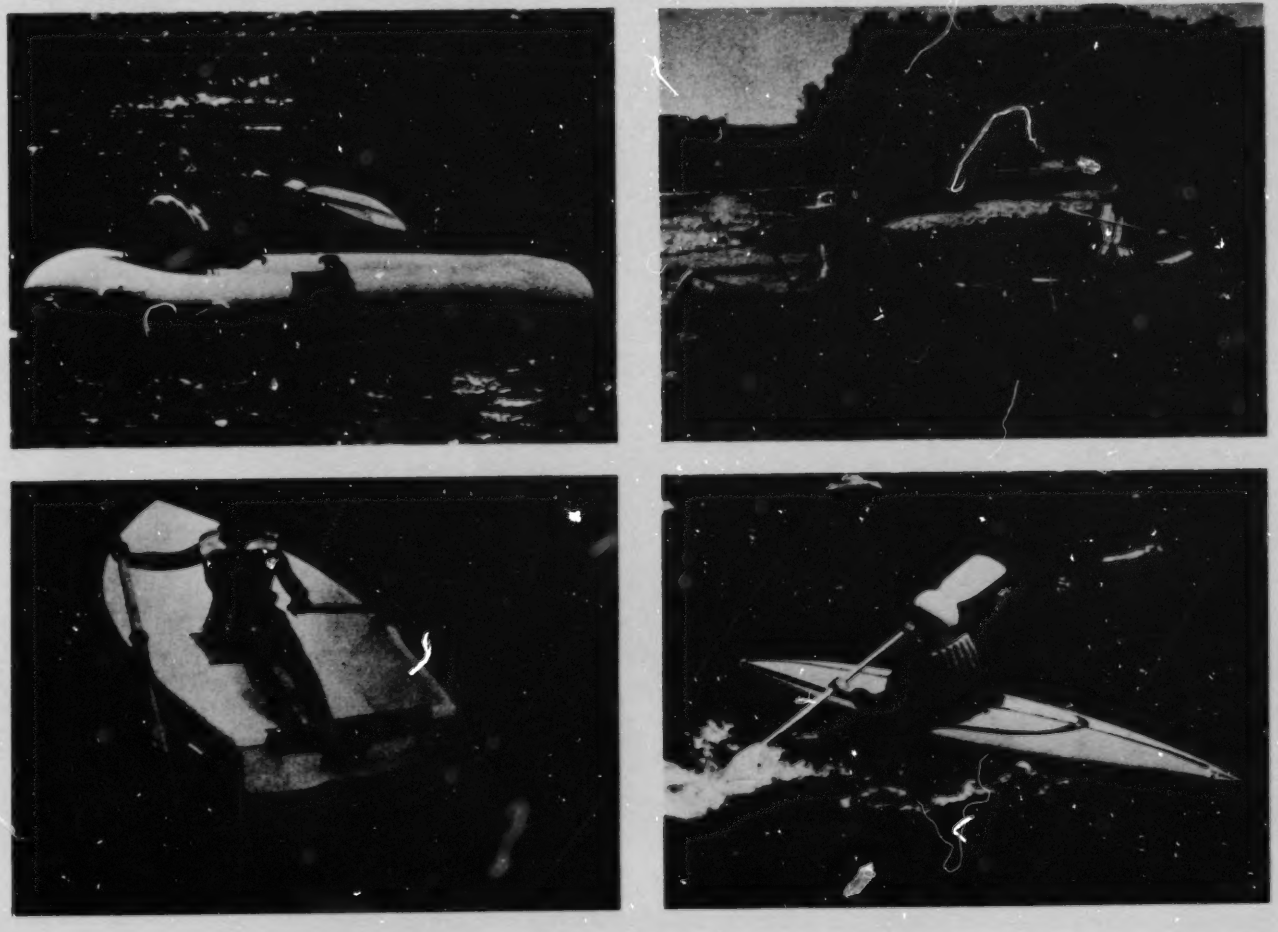
Rowing a dinghy or paddling a canoe or kayak can do wonders for a person's upper-body strength, and it can provide valuable learning experiences in basic boating. Another benefit of hand-powered boating is that it increases one's sensitivity to the water environment. The small size of the craft makes the user immediately aware of—and respectful of—the ways in which overloading and improper weight distribution can affect the stability of a boat. Put your weight where it does not belong in a canoe, for example, and the next instant you may find yourself in the water, with the capsized canoe drifting rapidly out of reach. Or put too many people in a rowboat that does not have much freeboard (height above the waterline at the sides), and suddenly the boat may begin filling with water and going down. The knowledge and skills required for safe operation of manually powered watercraft are fundamental to all levels of boating.

Wind-Powered Watercraft

Steamships and motor vessels are comparatively recent developments in the long history of water transportation. Until late in the nineteenth century, the world's commercial waterways were dominated by sailing vessels. The magnificent square-rigged clipper ships that marked the end of the Age of Sail are no longer with us, but wind-powered vessels—in the form of recreational sailboats—are more numerous than ever. (See Fig. 1-2.)

In the past, owning and operating a sailboat was a recreational activity enjoyed mainly by dedicated amateur sailors who were prepared to spend a lot of time and money in pursuit of their hobby. Sailboats con-

Fig. 1-1. Manually powered watercraft



structed by traditional methods and with traditional materials were expensive to buy and keep in good condition, and they were often heavy and hard to handle. Today, however, almost any boating enthusiast who wants to experience the pleasures of sailing can do so. Modern technology has made possible sailboats that are not only affordable and easy to maintain but also light, strong, and highly maneuverable.

Most sailing is done on fairly large bodies of water. Because of their relatively deep keels, sailboats require deeper water than manually powered craft or motorboats, and they can be difficult to maneuver in tight quarters. Operating a sailboat calls for some special skills beyond those that are fundamental to all boating. For example, a sailor must know how to trim the sails of his or her craft to take best advantage of the available wind and be able to correct the trim in a hurry if the wind should suddenly change. Learning to respond quickly and in the right way to changing conditions is part of the challenge of sailing.

Mechanically Powered Watercraft

The most popular type of recreational watercraft is the outboard motorboat (commonly called simply an outboard). Outboards are versatile craft that are used on most inland and sheltered coastal waters for cruising, waterskiing, fishing, racing, or simply getting from one place to another. Inboard motorboats have basically the same uses as outboards, but they are generally somewhat larger, heavier, and more expensive, and they must be transported by trailer. (See Fig. 1-3.) A small outboard motorboat often can be carried on a rack on top of a car, with the motor stowed in the trunk.

Modern powerboats are almost as easy to drive as the family car, but this advantage also carries a penalty: the responsive controls and predictable handling of the craft may dull the operator's awareness of the hazards that every boater must learn to recognize and guard against.

Responsibilities of the Boater

As the skipper of a pleasure boat, you must accept a great deal of responsibility as soon as you take control of the vessel. You are morally and legally responsible not only for the boat but also for the lives and well-being of everyone on board (including any water-skier you may have in tow). Your responsibility extends also to other persons on the water or ashore whose safety, well-being, or property could be affected by the way you operate your vessel. For example, you may be liable if your wake rocks another boat so violently that it damages the boat or its contents or causes injury to any of its passengers or crew.

Another responsibility all boaters share is to be watchful for reckless or inexperienced operators. You

Fig. 1-2. Sail-powered watercraft

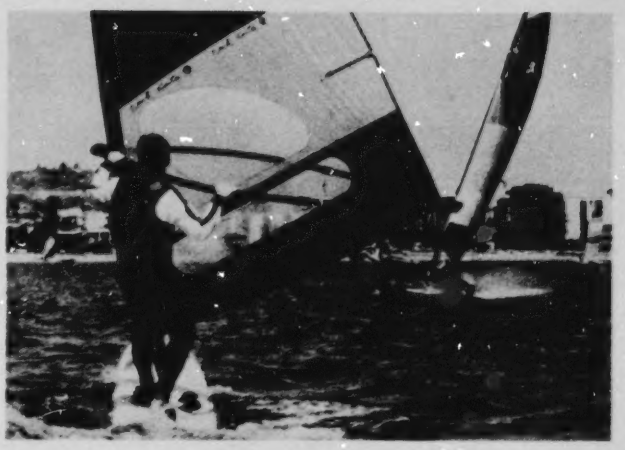
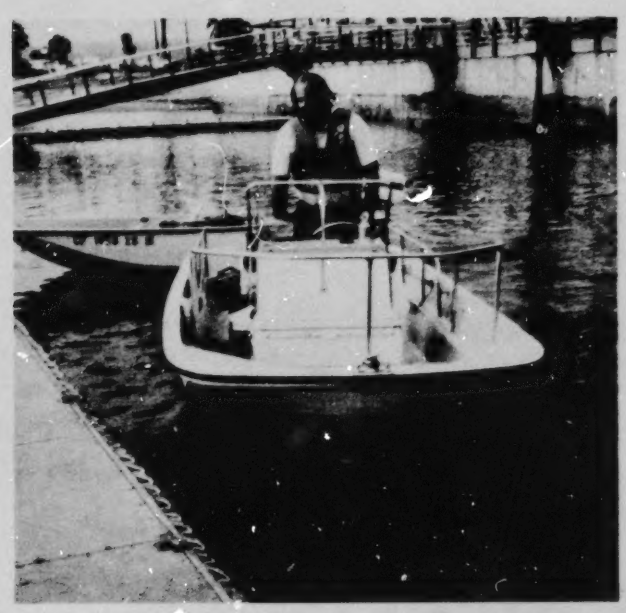


Fig. 1-3. Some popular types of motorboats



should be tolerant of another boater's minor mistakes if they do not threaten anyone's life, limb, or property, but you should not hesitate to call to the boater's attention—or to the attention of the authorities, if necessary—any behavior or condition that you think is dangerous.

The California Boating Law

Just as there are laws governing the operation of motor vehicles on the highways, there are laws governing the operation of vessels on the waterways. The laws that apply to watercraft vary somewhat according to their basis of authority and level of enforcement (national, international, state, or local). Ships at sea are governed by international navigational rules; boats on inland and coastal waters are governed by federal inland navigational rules and by state and local boating laws. The state laws that govern boating in California are known collectively as the California Boating Law. The booklet *ABCs of the California Boating Law* contains the main provisions of the law in brief form. A copy of the booklet is included with this book.

The California Boating Law requires that no one shall operate any watercraft in a reckless or negligent manner. Some examples of reckless operation are speeding in confined or restricted areas; "buzzing" or wetting down bathers, water-skiers, or other boaters; crossing over or fouling the towline of another vessel that is towing a water-skier, or passing your own towline over another vessel or water-skier; and failing to yield the right-of-way to another vessel when the navigational "rules of the road" and good seamanship require that you do so. Examples of negligent operation include failing to ensure that your vessel is seaworthy, properly equipped, and not overloaded before you leave the dock; neglecting to have readily available on your vessel a U.S. Coast Guard approved personal flotation device (PFD) in serviceable condition for every person on board, including every water-skier; and neglecting to have a qualified observer aboard when you are towing a skier.

The purpose of the California Boating Law is to prevent accidents, not to keep you from enjoying full use of the state's waterways. Because of their importance for your safety on the water and the safety of others, the rules of the road and other laws pertaining to boats and their equipment will be discussed in appropriate places throughout this book.

A Word About Drinking and Drug Abuse

Some boaters seem to regard an outing on the water as an occasion for drinking as much beer, wine, or hard liquor as possible in as short a time as possible. Or they may try to "enhance" the boating experience by getting high on drugs. Either way, they are asking for trouble of a kind you would be wise to avoid. For the luckier ones, the trouble may be just some damage to their own or another person's boat as a result of an alcohol- or drug-induced piloting error, or it may come in the form of a fine or a jail sentence for operating a boat while under the influence of alcohol or an illicit drug. For those who are less fortunate, the result of mixing boating with drinking or drug abuse may be a major accident in which someone is severely injured or killed.

You should give serious thought to the ways in which alcohol and other behavior-altering substances can impair your ability to think clearly, interpret correctly what you see and hear, and react quickly and in the right way in an emergency. Numerous research studies have confirmed these effects of alcohol and drugs, but some people still believe that a few drinks or the use of drugs will actually improve their thinking and their performance. Persons under the influence of alcohol or drugs may feel supremely confident of their ability to cope with any situation, but in fact they are functioning at a level much below normal. This combination of exaggerated self-confidence and reduced capacity makes such persons especially vulnerable to accidents.

Chapter Two

Understanding the Water Environment

- What is the water cycle, and what are its various phases?
- Where can a boater get information about local water conditions?
- What are some sources of weather information for boaters?
- What aspect of a storm gives boaters the most trouble?
- How do thunderstorms develop?
- What is hypothermia, and how can a boater guard against it?
- In what way does darkness transform the water environment?

A basic requirement for safe and enjoyable boating is a thorough knowledge of the water environment and how it is influenced by wind, weather, the tides, obstructions in or on the water, and the characteristics of the surrounding terrain. The kinds of water that will be of greatest concern to you depend on the kind of boater you are. If you are a kayaker, for example, your main interest may be in swift mountain streams that offer the challenge of "white water." If you are a sailor, your notion of ideal water might be a large coastal bay with a steady breeze blowing in from the sea. If you prefer motorboating, you may think of water in terms of a smooth, clear lake in the foothills. Whatever your choice of water environment, you can expect to have new experiences there that are very different from land experiences, and you must prepare for them.

The Water Cycle

The water you need for boating arrives on land in the form of rain or snow, then runs into watercourses and basins to form streams, rivers, and lakes. Eventually it finds its way back to its ultimate source, the ocean. Water reenters the atmosphere by evaporation, mainly from the oceans but also from lakes, reservoirs, rivers, and other water bodies. Additional moisture is contributed to the atmosphere by plant life through the process of transpiration. The moisture that is drawn up into the atmosphere in currents of warm air forms into clouds, and when the right conditions of temperature and humidity are present in a cloud mass, the moisture condenses and falls to earth as rain or snow—and the water cycle begins again. (See Fig. 2-1.)

One aspect of the water cycle deserves your special attention. A great deal of snow accumulates in California's mountains during the winter, and the runoff water that comes from the melting snow in the spring is very cold and tends to stay that way as it comes down the slopes. Consequently, any stream or body of water that is fed by the runoff or by cold water stored

behind a dam will also be cold—sometimes too cold for your safety if you should fall into the water and remain there too long. For example, a person exposed to near-freezing water will become exhausted and usually lose consciousness within 15 minutes after falling in. Death can follow very quickly after that, either from drowning or from hypothermia (abnormally low body temperature). Hypothermia and its effects will be discussed in greater detail later in this chapter.

Currents and Tides

Any continuous, predominantly horizontal movement of water in a given direction is called a current. A current may be movement of an entire body of water in a channel, for example the flow of a river or a stream, or it may be a flow occurring at any depth within a larger body of water. Currents may be relatively steady, as in a slow-moving stream in the flatlands, but usually they are dynamic and ever-changing. Any change or obstruction in the path of a current will alter the flow in some way. The current may change direction, gain or lose velocity, split into two or more currents, or even break up into turbulences and disappear. When a river or a stream empties into a lake or an estuary, the current soon dissipates in the larger body of water, but until then it can be a hazard to small craft.

All watercraft are affected to some extent by currents. Sail-powered and manually powered craft are affected most particularly on bodies of water where the currents are strong and variable, as is often the case in rivers and streams. A sailboat or a canoe can move against the current, but it may not always be able to move fast enough to avoid drifting backwards. Any boat that is traveling with the current must be able to move faster than the current; otherwise it will be difficult or impossible to steer. Currents give motorboats relatively little trouble, but even a powerful boat can be completely at the mercy of the current if its motor fails. (A prudent motorboater will carry a paddle and an anchor and line aboard for use in such an emergency.)

The energy contained in a current can be helpful or harmful in a boating situation, depending on the boater's skill in dealing with it. For example, a river rafter cannot make much headway without help from the current, but he or she can quickly get into trouble by not keeping alert to changes in the current's direction or velocity.

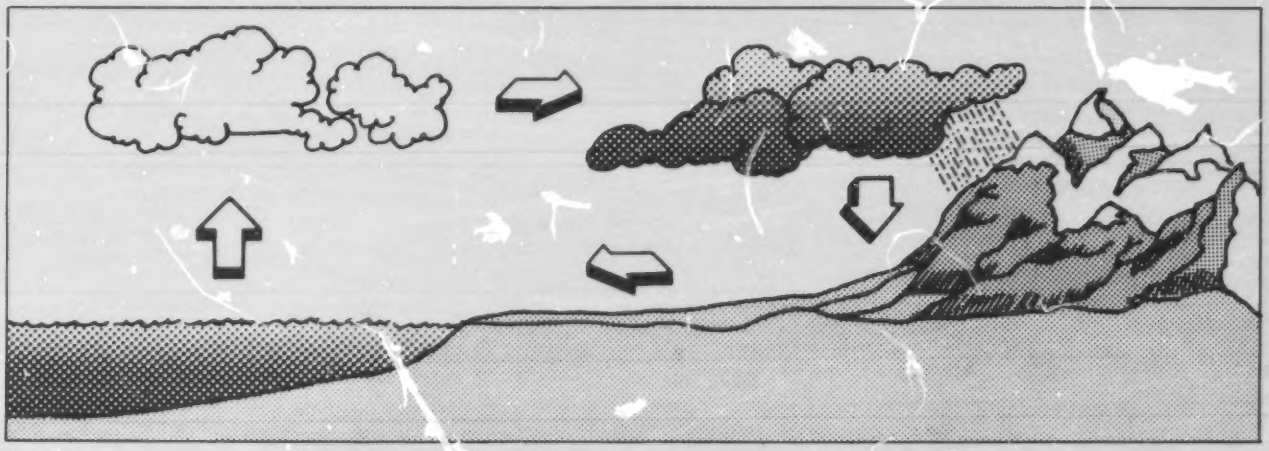
River Currents

Gravity is the primary force that moves water in a river or a stream. The speed and other characteristics of the current at any point along the watercourse are determined by the steepness of the terrain, the volume of water that is flowing, and the width and shape of the channel the water is flowing through. For example, the current of a river or a large stream will be very fast where it flows through a narrow passage, much to the delight of kayakers and white-water rafters (so named because they like to ride through the rough parts of wild rivers like the Tuolumne and the American in northern California).

Ocean Currents

Currents of many kinds are present in the oceans. The largest of them extend over great distances and move in semipermanent, roughly circular patterns. They are caused mainly by prevailing winds and are influenced by the rotation of the earth, which tends to make waters circulate to the right (clockwise) in the northern hemisphere and to the left (counterclockwise) in the southern hemisphere. Temperature differences in the water and between the air and the water also contribute in complex ways to ocean currents.

Fig. 2-1. The water cycle



Of greater concern to recreational boaters are the smaller, local ocean currents that are present in coastal waters, inlets, and bays. They are produced by local winds and the tides, and they are affected by the shape of nearby land masses. For example, strong tidal currents may develop in a strait between a nearby island and the shore during certain times of the day.

The Tides

Tides are caused by the gravitational effects of the sun and the moon. Because of its closeness to the earth, the moon contributes most of the force that is responsible for the tides (about twice as much as the sun). The tide rises and falls approximately twice a day. Because the moon is slowly orbiting the earth in the same direction that the earth is turning, the complete cycle of two high tides and two low tides actually begins about 50 minutes later each day.

In California the average difference in water level between high tide and low tide is about four feet; this means that in many places a great amount of water moves toward shore when the tide is rising and away from shore when the tide is falling. The movement of all that water can significantly affect the handling of a boat. For example, the current that flows from San Francisco Bay into the ocean at the peak of the outgoing tide is so strong that only a boat with a powerful motor can overcome it and make headway through the Golden Gate.

The tides also determine to some extent where a boat should and should not go. An area that is completely under water at high tide may be completely out of the water at low tide, and a boat that enters the area when the tide is in and remains there too long may end up stuck in the mud. The danger of being grounded by a falling tide is greater for a sailboat than for a motorboat or other vessel with a relatively shallow draft. A channel that is deep enough at high tide to permit a sailboat to pass through may not contain enough water a few hours later to provide clearance for the boat's keel. (See Fig. 2-2.)

A boater who plans to enter waters that are affected by the tides must know how the tides influence those waters and when high and low tides will occur. Newspapers in communities near tidal waters usually publish tide tables that indicate the daily times and heights of high and low waters in the area. Current tables that indicate daily slack-water times (when there is little or no movement of the water as the result of tidal currents), maximum-current times, and current velocities

Fig. 2-2. Tide range

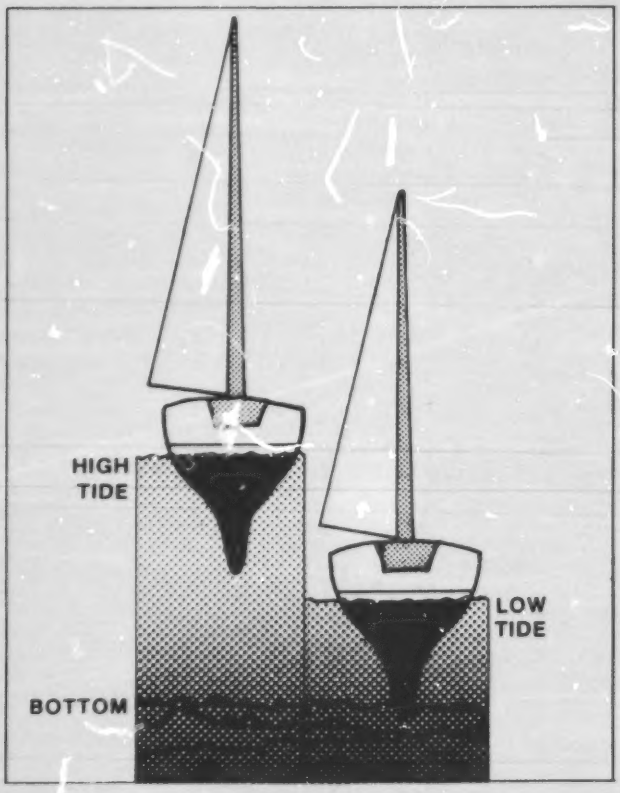


Fig. 2-3. Tide table (excerpt)

SAN FRANCISCO (Golden Gate), CALIFORNIA, 1984

Times and Heights of High and Low Waters

JUNE

Day	Time	Height		Day	Time	Height	
	h m	ft	m		h m	ft	m
1	0622	-1.3	-0.4	8	0059	1.2	0.4
F	1406	4.5	1.4	F	0657	4.0	1.2
	1803	3.2	1.0		1232	0.6	0.2
					1935	5.9	1.8
2	0009	6.0	1.8	9	0155	0.4	0.1
Sa	0707	-1.3	-0.4	Sa	0818	4.0	1.2
	1456	4.5	1.4		1327	1.1	0.3
	1857	3.3	1.0		2015	6.1	1.9
3	0055	5.8	1.8	10	0248	-0.4	-0.1
Su	0756	-1.2	-0.4	Su	0933	4.2	1.3
	1547	4.6	1.4		1416	1.6	0.5
	1957	3.3	1.0		2055	6.4	2.0
4	0150	5.5	1.7	11	0334	-1.0	-0.3
M	0850	-1.0	-0.3	M	1039	4.4	1.3
	1633	4.7	1.4		1506	2.1	0.6
	2114	3.1	0.9		2134	6.5	2.0
5	0253	5.1	1.6	12	0419	-1.3	-0.4
Tu	0945	-0.7	-0.2	Tu	1136	4.5	1.4
	1727	4.9	1.5		1557	2.5	0.8
	2235	2.7	0.8		2213	6.5	2.0
6	0405	4.7	1.4	13	0505	-1.4	-0.4
W	1041	-0.3	-0.1	W	1231	4.7	1.4
	1813	5.2	1.5		1643	2.8	0.9
	2355	2.0	0.6		2255	6.4	2.0
7	0527	4.3	1.3	14	0547	-1.4	-0.4
Th	1138	0.1	0.0	Th	1324	4.7	1.4
	1854	5.6	1.7		1733	3.0	0.9
					2334	6.2	1.9

BEST COPY

usually accompany the tide tables. (See figs. 2-3 and 2-4.) The National Weather Service also broadcasts tide information.

Weather

Weather can make or break your day on the water. If the weather turns bad while you are out in your boat, you could be in serious trouble. Bad weather does not necessarily mean a storm. It can be just a strong wind or heavy rain or fog. Also, a storm does not have to be close by to cause problems; it can make waves that will be felt a long way from the actual storm center. Before you decide to venture out on the water in threatening weather, check weather reports and forecasts. If you are not sure you can cope with any expected heavy weather, or if your boat is not suitable or properly equipped for it, stay ashore.

If you must go out in uncertain weather, keep alert to changing weather conditions. Observe cloud formations; in general, high clouds mean high barometric pressure and fair weather, and low-hanging clouds mean low pressure and probable foul weather. Watch for shifting or steadily increasing winds, particularly an increasing wind that is blowing against a strong tidal current; the waves it makes can quickly become steep enough to capsize your boat.

If your boat is not equipped with a marine radio, you should if possible carry aboard a small transistor portable when bad weather threatens, preferably one that can receive National Weather Service VHF-FM broadcasts as well as standard AM radio broadcasts. Heavy static on the AM bands is usually a warning of an impending thunderstorm. Listen to the storm advisories that are broadcast by the National Weather Service and local radio stations, and keep in mind what every experienced boater knows: it is easier to stay out of trouble than to get out of trouble.

Fig. 2-4. Current table (excerpt)

SAN FRANCISCO BAY ENTRANCE (Golden Gate), CALIF., 1984

F-Flood, Dir. 065° True; E-Ebb, Dir. 245° True

JUNE

Day	Slack Water Time	Maximum Current Time	Vel.	Day	Slack Water Time	Maximum Current Time	Ve
	h.m.	h.m.	knots		h.m.	h.m.	knots
1	0118	0455	5.2E	8	0315	0604	2.5F
F	0847	1151	3.8F	F	0853	1133	3.0E
	1530	1735	2.1E		1509	1812	3.3F
	2022	2326	2.3F		2117		
2	0157	0541	5.1E	9		0021	4.0E
Sa	0933	1242	3.7F	Sa	0412	0708	3.1F
	1621	1826	2.0E		1007	1238	2.8E
	2110				1603	1903	3.3F
					2159		
3		0013	2.1F	10		0110	4.6E
Su	0242	0630	4.9E	Su	0504	0805	3.7F
	1022	1331	3.6F		1112	1339	2.6E
	1714	1917	1.9E		1653	1948	3.2F
	2215				2241		
4		0108	1.9F	11		0158	5.1E
M	0337	0724	4.6E	M	0553	0858	4.1F
	1117	1426	3.4F		1211	1433	2.5E
	1808	2015	2.0E		1741	2033	3.1F
	2329				2322		
5		0213	1.8F	12		0242	5.4E
Tu	0444	0818	4.2E	Tu	0639	0946	4.3F
	1214	1523	3.3F		1304	1522	2.4E
	1859	2118	2.2E		1827	2119	3.0F
6	0054	0323	1.8F	13	0003	0325	5.5E
W	0605	0921	3.7E	W	0724	1033	4.3F
	1313	1623	3.3F		1353	1608	2.3E
	1948	2223	2.7E		1912	2201	2.9F
7	0210	0445	2.0F	14	0044	0408	5.4E
Th	0731	1029	3.3E	Th	0808	1118	4.2F
	1412	1720	3.3F		1440	1649	2.2E
	2033	2323	3.3E		1955	2243	2.6F

Wind

Wind is probably the most serious consequence of bad weather for the boater. It causes waves and makes the water choppy, and it may bring with it a lot of cold air. A strong wind can make a boat difficult to handle and keep on a true course, slow the boat down, and perhaps even bring it to a halt by capsizing it. Even a powerful motorboat will be slowed by a strong headwind or driven off course by a strong beam wind (a wind coming from the side), and the operator may be kept busy trying to maintain the desired speed and heading. Also, the extra power needed to offset the effects of the wind will increase the motorboat's fuel consumption.

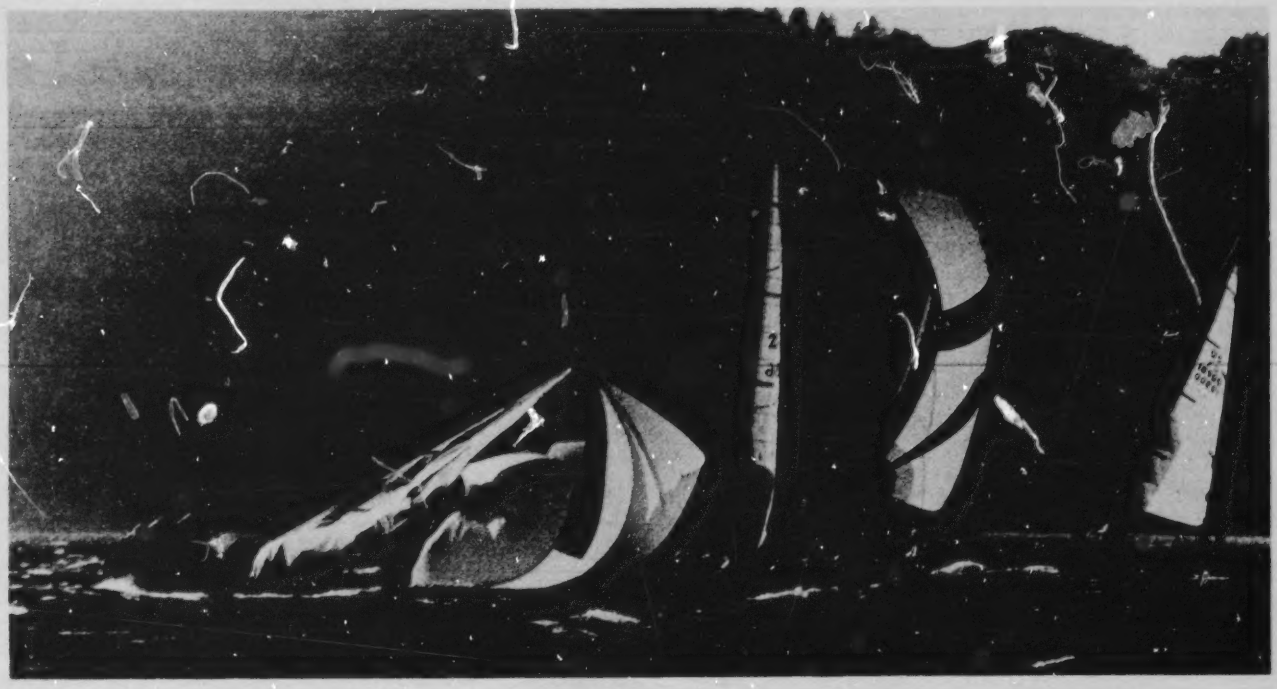
A properly trimmed and well-handled sailboat can ride out almost any wind that is not too strong or erratic, but most sailboats are designed to perform best in light-to-moderate winds (winds of 5 to 15 miles per hour). When the wind gets much stronger than that, several dangerous possibilities emerge: the sails may tear and become flags instead of means of propulsion; the mast may break, bringing sailing to a halt for the day and perhaps injuring someone seriously when it falls; or the boat may heel over so far that it cannot recover. (See Fig. 2-5.)

When the wind is especially strong, the usual procedure with a powerboat is to head almost into the wind and reduce speed; this lessens the chance that wind-driven waves will swamp or capsize the boat, and it makes for a smoother ride. This is not a practical maneuver for a sailboat, however, since a boat under sail cannot make headway directly into the wind. Long before the wind becomes dangerously strong, the sailor should make for port or other safe location, if necessary dropping and securing sails and proceeding under power of the auxiliary motor. (A sailboat can make progress under sail against a moderate wind by tacking, a procedure that will be described later in this book.)

If the wind is too strong for safe sailing with full canvas and the boat does not have an auxiliary motor, the sailor has two choices: drop and secure the sails,

BEST COPY

Fig. 2-5. Knockdown



then anchor and wait for the weather to improve; or reduce the sail area by dropping a sail, changing sails, or reefing (tying back part of a sail). Reducing the sail area will lessen the chance of a knockdown.

A strong wind is a major hazard to canoes and kayaks. Because such craft sit relatively high in the water and have narrow beams, the combined forces of the wind and wind-driven waves can easily turn them over. Even if the canoe or kayak remains upright, the wind can make it very difficult to maneuver. (A rowboat has a broader beam than a canoe or a kayak and therefore has more surface in contact with the water, and this makes it more stable and easier to keep pointed in a desired direction.)

If you are a canoeist or a kayaker and are out on a lake or in coastal waters when a storm threatens, you should make for shore without delay. If you wait too long and are caught in the storm, try to keep your craft pointed into the wind as much as possible as you make your way to shelter; that way, you are less likely to be turned over by the action of the wind and waves.

If you are caught in a storm in any kind of boat on a river, you will have to contend with current in addition to wind and rough water. Again, the best thing to do is get to shore as quickly as possible. If you have time, return to the dock or launching area and tie up securely or remove the boat from the water; but if the storm is coming up too fast, make for the nearest suitable landing, and when you and your passengers are safely ashore, get the boat out of the water if possible. If you cannot do so, tie the boat to a fixed object on shore—preferably with lines from both the bow and the stern—so that it will not drift away or be damaged by wind or wave action.

You should learn about the wind and weather patterns in the places where you intend to go boating. In coastal regions, for example, winds often are light in the morning and build to gusts in the afternoon, then diminish as darkness approaches. Or you might notice that during the summer months at your favorite lake, the wind typically blows from early morning to midmorning and is quiet during the middle of the day, then picks up again in the late afternoon and evening. If you plan to sail on the lake, it will obviously be to your advantage to be aware of the wind pattern you are likely to encounter there—that in the middle of the day you can expect to float rather than sail. Knowledge of the wind pattern on the lake will also be useful to you if you are a canoeist; paddling across a lake is hard work, but doing so against a brisk wind is much harder.

Hypothermia

Wind can also be a hazard on the water because of its cooling effect. Besides numbing your fingers and toes and making you feel generally uncomfortable, a cold wind can lower your temperature enough to interfere seriously with your body functions. This abnor-

mal reduction in body temperature is called hypothermia. Hypothermia can be fatal under severe conditions. For example, if you fall into cold water and remain there too long or do not receive proper medical attention after you have been rescued, your chances for survival are slim.

Wind-induced hypothermia. Exposure to a cool wind is usually not life-threatening, but if the wind is cold enough and you are exposed to it long enough, you may experience muscle spasms, arm and leg cramps, and general stiffness. Also, since your body will be working hard to replace its lost heat, you will probably feel tired, and you may become sleepy and confused. Any of these symptoms of hypothermia can make it difficult for you to move about, keep your balance, and react quickly in an emergency.

Wind can rob you of body heat in several ways. It takes some of your body heat with it as it blows around you, and if it is a cold north wind you will lose heat even faster. (Even if there is no wind, your body will lose heat to surrounding cold air by radiation.) Wind can also reduce your body heat by speeding up the evaporation of moisture from your skin and clothing. When moisture evaporates from a surface, it takes with it a great deal of heat, which in this case is supplied by your body. These combined effects of the wind can produce wind chill, a condition that makes the air seem much colder than it actually is. Wind chill can be especially dangerous if your clothing gets wet from rain or from spray kicked up by your own or another boat. Water-skiers are particularly vulnerable to wind chill and hypothermia because they have so little protection against wind, water, and spray.

Hypothermia resulting from exposure to cold water. Hypothermia that is caused by prolonged exposure to cold water is extremely dangerous. Heat is conducted away from the body much more rapidly by cold water than by cold air. A hypothermia victim loses consciousness when his or her body temperature drops below about 90° F. (32.2° C.), and in near-freezing water this can occur within 15 minutes. A person who is unconscious in the water and is not promptly rescued is almost certain to drown unless he or she is wearing a personal flotation device (PFD) of the type that keeps the face of an unconscious person out of the water. Even if they do not drown, few persons can survive longer than 45 minutes in near-freezing water. By that time, the victim's body temperature has usually fallen to 85° F. (29.4° C.) or less, and heart action may stop. The expected survival time increases as the water temperature increases, but hypothermia can kill even in water that is well above the freezing point. (See Table 2-1.) Your body size, age, and general health also influence your chances for survival.

Cold water in rivers and streams. A white-water stream that is fed by melting snow or cold mountain springs can be dangerously cold, especially in its upper reaches. Farther downstream, the current begins to slow as the terrain flattens and the channel widens, and the white water gradually disappears. The slower-moving water begins to warm as it flows over the warmer ground of lower elevations.

The greater the volume of water in a stream or a river, the more slowly will the water take on heat from its surroundings and from the sun. If the volume of water is contained in a narrow but deep channel, it will have less exposure to the sun and will therefore warm more slowly than if it extends over a wide and shallow riverbed. Similarly, a stream or river whose path takes it through shade most of the day will be cooler than one that has full exposure to the sun.

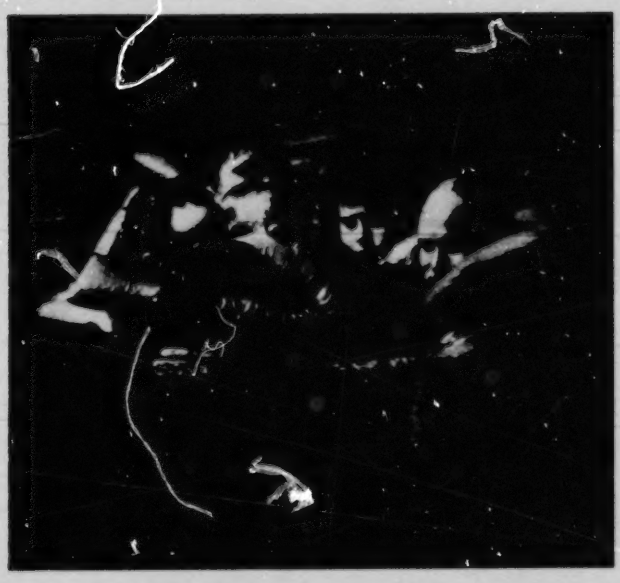
Protecting yourself against hypothermia. As with any other boating hazard, the best way to protect yourself against hypothermia is to avoid the conditions that cause it. That will be easy if you boat only where the water and the weather are warm and calm and the wind is just strong enough for leisurely sailing. Then you need only keep alert to changes in the weather and make for shore if a storm threatens. However, few boating enthusiasts are willing to wait for such a com-

Table 2-1. Effects of Exposure to Cold Water

Water temperature	Time to exhaustion or unconsciousness	Expected survival time
32.5° F. (0.3° C.)	15 minutes or less	Under 15 to 45 minutes
32.5 to 40° F. (0.3 to 4.4° C.)	15 to 30 minutes	30 to 90 minutes
40 to 50° F. (4.4 to 10° C.)	30 to 60 minutes	1 to 3 hours
50 to 60° F. (10 to 15.6° C.)	1 to 2 hours	1 to 6 hours
60 to 70° F. (15.6 to 21.1° C.)	2 to 7 hours	2 to 40 hours
70 to 80° F. (21.1 to 26.7° C.)	3 to 12 hours	3 hours to indefinite

Fig. 2-6. Conserving body heat

Fig. 2-7. Huddling for warmth



bination of favorable conditions before venturing out, and many prefer a more challenging water environment; kayakers and white-water rafters come immediately to mind. If your kind of boating takes you where exposure to wind and spray or rain—or perhaps a fall into cold water—could present the threat of hypothermia, you and any others aboard your craft should wear suitable protective clothing or at least have it readily available for use if changing conditions require it.

If you fall into cold water as a result of a capsize and your craft remains afloat, get back into or on the boat so that as much of your body as possible will be out of the water. Especially try to keep your head out of the water; more than half of your heat loss can occur from your head and neck. If you must remain in the water while awaiting rescue, conserve your body heat by avoiding unnecessary movement. You will lose heat about one-third faster if you swim or tread water than if you remain still.

A further means of conserving body heat in cold water is to fold your arms over your chest and draw your knees up, but you must be wearing your life jacket to do this. (See Fig. 2-6.) If you are in the water with several other persons who are also wearing life jackets, you can huddle close together for warmth, side-by-side in a circle. Any children in the group should be kept in the middle of the circle. (See Fig. 2-7.)

Importance of your life jacket. Experienced boaters who know and respect the hazards of the water environment will not go onto the water without wearing a life jacket. A snug-fitting life jacket not only gives you the extra buoyancy you need if you fall in the water; it also helps to keep you warm in or out of the water. Protective clothing and life jackets for boaters are described in Chapter Three; first aid for hypothermia victims is discussed in Chapter Seven.

Fog

Fog is actually a cloud that is close to or in contact with the surface of the earth. Like other kinds of clouds, it is the result of condensation of moisture in the air. The type of fog you are most likely to encounter on the water is called advection fog. It is caused by moist air moving over a cooler surface, as when warm, moist air from inland or from the ocean moves across cold coastal waters.

Boating in foggy waters is extremely dangerous. A low, dense fog can make it difficult or impossible for you to see anything even a few feet away, and since visibility will be just as bad for everyone else on the water, the risk of collision will be great. (See Fig. 2-8.) Commercial boats that may be in the vicinity are a special hazard. Business schedules often require them to remain under way in weather that would not be

suitable for pleasure craft, and if you are on a collision course with a commercial vessel in a dense fog, you and the skipper of the other boat might not see each other soon enough to avoid disaster. The larger vessel will probably be equipped with radar, but your small boat might not show up on the radar screen. Keep in mind also that a big boat cannot readily change direction or speed. Common sense suggests that if any evasive action has to be taken, you should be the one to take it.

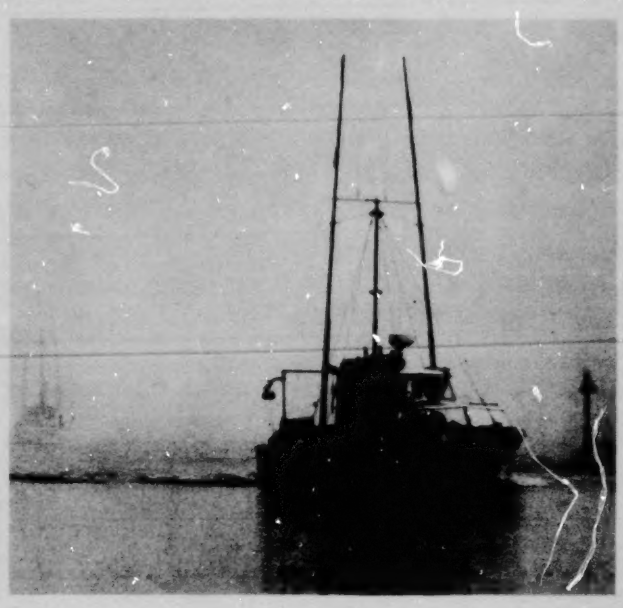
Your best defense against fog is to stay out of it if you can. However, if you are out on the water and are in danger of being enveloped by fog, your first thought should be to head for port or some other safe location as soon as possible. If the fog is coming on fast, however, you might prefer to get out of the main channel and drop anchor until conditions improve. If you decide to brave the fog and come in, you should first take a compass reading on your desired destination, then cover as much water as you can in that direction before the fog closes in.

When you are in the fog, reduce your speed and make sure your running lights are on. (All vessels are required to show running lights between sunset and sunrise and during periods of restricted visibility.) Try to run as quietly as possible so that you and others aboard can listen for bells, whistles, wave action, the motors of other vessels, and any other sounds that could warn you of hazards or help you navigate safely. If your craft is a motorboat, stop the motor briefly from time to time so that you can listen more closely, but stay ready to restart the motor quickly if you should need it for maneuvering. Also, it will be helpful if you have someone aboard who can serve as a lookout. Station the lookout as far forward as possible (but not sitting on the foredeck or bow) so that he or she will be away from motor noise. Be sure to sound your horn or whistle at the required intervals to warn other vessels in the area that you are under way. Powerboats making way in or near areas of reduced visibility must sound one prolonged blast (four to six seconds long) at least every two minutes; when not making way, powerboats must sound two prolonged blasts at least every two minutes. Sailboats must sound one prolonged blast plus two short blasts (about one second each) at least every two minutes.

Storms

Few recreational boaters will ever have to face the wild fury of a storm at sea; contending with that kind of heavy weather far from any sheltering landfall is a challenge most prefer to leave to ocean racers and other hardy "blue-water" types. Fortunately, most of the storms you are likely to encounter on California's inland and coastal waters are easier to deal with than storms at sea, although they present many of the same

Fig. 2-8. Boat in reduced visibility



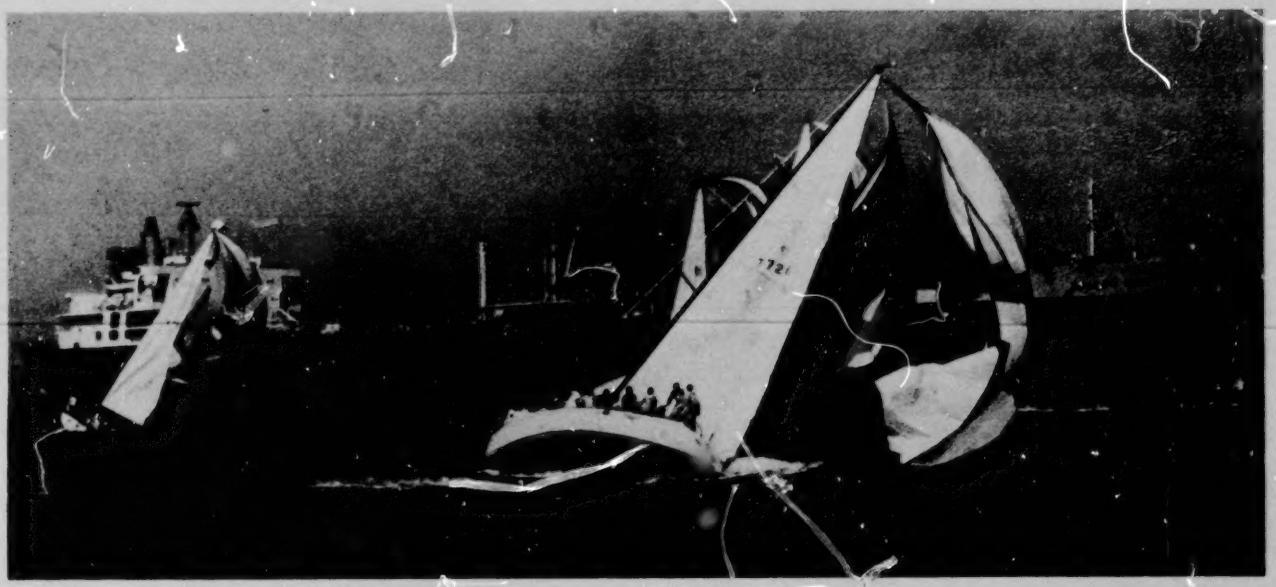
problems on a smaller scale. (See Fig. 2-9.) You should learn to recognize the weather-advisory flags and lights that are displayed at Coast Guard stations, yacht marinas, municipal piers, and other selected locations in and near boating areas.

Some of the problems associated with stormy weather are manageable, and others are best avoided. Rain alone, for example, is seldom a threat to a boater who is prepared for it, although a heavy rain can cause poor visibility; but if the rain is being driven aboard by a strong wind that is also causing heavy wave action and kicking up spray, the result may be not only poor visibility but also equipment failure (perhaps including failure of the engine or the radio). And as we have learned, wind and rain can result in hypothermia if persons aboard are not wearing appropriate clothing.

Thunderstorms are a special menace. They usually come on rapidly—often within an hour—and any unlucky boater who fails to head for port at the first signs of a thunderstorm may have to contend with violent and unpredictable winds, dangerous waves, drenching downpours, and lightning. Thunderstorms are not so common in California as in other parts of the country, but since they can take you by surprise and do a lot of damage when they do occur, you should learn to recognize the changes in the weather that announce their coming.

Thunderstorms are most likely to occur on warm, humid, summer afternoons. In the early stages of a typical thunderstorm, a cold air mass begins to move in under a warm air mass and force it upward. The lighter warm air begins to rise rapidly, gaining buoyancy

Fig. 2-9. High-wind sailing



and velocity and expanding and losing heat as it moves up into thinner and colder air. As the rising warm air expands and cools, the moisture it is carrying condenses and forms a large, fluffy, but very active cloud, often in combination with other clouds in the vicinity. The cloud mass quickly grows larger and taller, developing into what is commonly known as a thunderhead. Winds rush up through the thunderhead as if it were a chimney, and the cloud mass rises to great heights. Moisture in the rapidly cooling thunderhead condenses further, and rain begins to fall, accompanied by strong downdrafts of cold air that increase in velocity as they approach the water. With the wind and rain come lightning and thunder, and the thunderhead becomes a churning mass of wind, rain, and electrically charged clouds in which a light aircraft could be torn apart. Winds on the water below will also be moving at high speed, making tall waves. Boats in the area—especially small, open ones—may be in danger of capsizing. When the thunderhead reaches an altitude of about 35,000 feet (10 668 metres), it encounters strong, steady winds that cut off its top and give it an anvil shape. (See Fig. 2-10.) Soon after that, the thunderstorm is over.

Thunderstorms have short lives—usually only one or two hours—but the amount of energy they generate in that brief time is awesome. Some of that energy is expended in the form of lightning. Lightning is especially hazardous to boaters because it is attracted to tall objects such as poles and masts and to efficient conductors of electricity—and water and metal are two of the most efficient. Some boats are equipped with lightning arresters, which intercept the lightning and divert it harmlessly through a grounding cable into the water. The effects of lightning are unpredictable, however, and even if your boat is equipped with an arrester, the safest place to be during a thunderstorm is ashore. If you are out on the water in a thunderstorm, you should as much as possible avoid contact with metal items, electrical equipment, cables, and wet lines

Fig. 2-10. Thunderhead

Darkness and Unfamiliar Waters

Most experienced boaters prefer to stay off the water after the sun goes down. Darkness transforms the water environment in subtle ways: distances become difficult to judge; familiar landmarks are no longer where they should be, or they seem to be something else; and the waters that you navigated with confidence a few hours earlier are now full of real and imaginary hazards. (See Fig. 2-11.) The real hazards will outnumber the imaginary ones if you are out at night in unfamiliar territory or where bad weather, tides, currents, or the possibility of collision with other boats add to your problems.

With darkness there also comes increased danger from cold. The air temperature usually drops significantly after the sun goes down, and if there is a lot of moisture in the air or if your clothing is already wet, the chill you feel may get worse and become hypothermia. You should have some extra clothing or blankets aboard if there is a chance that you will be on the water after dark.

Another reason to avoid boating at night is that if you have a breakdown or an accident, you may have to wait a long time—perhaps until morning—before someone finds you and offers help. You will be easier to find if your running lights are on; remember that all vessels operating between sunset and sunrise and during periods of restricted visibility must display them.

Boating in unfamiliar waters. Much of the pleasure of boating comes from the opportunity it provides for exploring new places. Before venturing out on unfamiliar waters, however, you should take time to learn about conditions there that might prove dangerous. For example, to avoid running aground or perhaps knocking a hole in your hull, you will need to know where the shallow water is and where you might encounter shoals, reefs, or underwater rock formations. You should also know what the tides are like (if there are any) and whether there are any potentially hazardous currents in the area. Knowledge of the local wind and weather patterns will also be helpful. And as always before going out on any body of water, you should check the weather forecasts for the area.

The nautical charts published by the National Ocean Survey in the U.S. Department of Commerce are excellent sources of information about local water conditions; they can be obtained at most stores that sell marine supplies and equipment. Other useful sources of such information include the local notices to mariners issued periodically by the U.S. Coast Guard; boating safety programs that may be offered by schools in the community; harbormasters and marina operators; and boat owners and operators in the area who are well acquainted with the local water environment.

Fig. 2-11. Boating at night

Chapter Three

Equipment for Safe Boating

- What safety equipment must an operator carry to meet legal requirements?
- What are the various types of personal flotation devices (PFDs)?
- When should a boater wear his or her life jacket?
- What running lights should a 30-foot sailboat display?
- What is the easiest way to increase the holding power of an anchor?
- What knot is best for making a temporary eye or loop in a line?
- What kinds of information can be found on a navigational chart?
- What are the advantages of planning boating attire by the layer method?

Few persons would knowingly venture out on the highways in an unsafe car, and fewer still would accept the risk of flying in a poorly maintained or improperly equipped aircraft. Likewise, anyone who is planning an outing on the water should be concerned about safety. Experienced boaters follow the example of airplane pilots; they methodically check their craft before each use to make sure that everything needed for a safe trip is in place and working properly. Certain items of boating equipment are required by law to be part of the vessel or carried aboard it. Other items are not legally required but are considered to be either essential or highly desirable for safe and efficient boating.

Required Equipment

The minimum equipment a recreational watercraft must have to meet legal requirements depends on the type and size of the craft, the waters on which it will be used, and whether it will be operated at night and during periods of restricted visibility. The information given in this chapter about required and recommended boating equipment is general; for specific requirements, see the booklet *ABCs of the California Boating Law*.

Personal Flotation Devices

All boats are required to carry at least one Coast Guard approved personal flotation device (PFD) in serviceable condition for each person aboard, including any water-skier in tow. Requirements vary according to the type and size of the vessel.

Wearable PFDs. Personal flotation devices are classified as either wearable or throwable. Wearable PFDs—commonly called life jackets, regardless of their style—are further identified as Type I, II, or III devices, depending on the degree of protection they provide. (See Fig. 3-1.) Type I PFDs (life preservers) provide the most buoyancy and are most effective for long exposures and in rough water. They have the added

advantage of being designed to keep an injured or unconscious person's face out of the water.

Type II PFDs (buoyant vests) have less buoyancy than Type I devices, but they are somewhat more comfortable. They can also keep the face of an unconscious person out of the water, but they are not as effective as Type I devices in this regard.

Type III PFDs include such devices as ski vests, canoe vests, sailing vests, and float coats. Float coats and jackets are available that look very much like regular clothing. Type III PFDs must meet the same minimum buoyancy requirements as Type II devices, but they are not designed to keep an unconscious person's face out of the water.

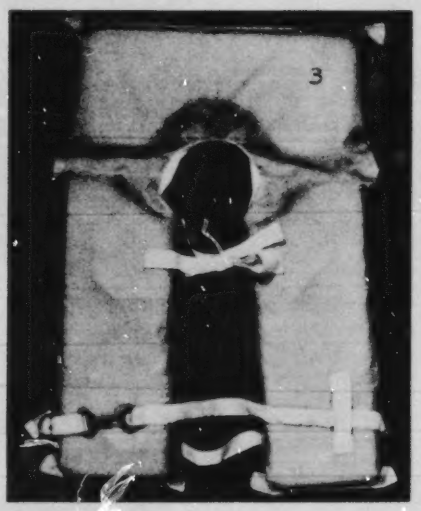
All boats, powered or nonpowered, must carry at least one Coast Guard approved personal flotation device for every person aboard. Failure to have a sufficient number of approved devices aboard constitutes a violation of state and federal law. The minimum requirements are:

1. Except canoes and kayaks, all boats 16 feet (4.88 metres) or over in length: One Type I, II, or III (wearable) for each person on board and one Type IV (throwable) in each boat.
2. Canoes and kayaks of any length and all other boats less than 16 feet (4.88 metres) in length: One Type I, II, III or IV PFD for each person on board.

You will be in compliance with the California Boating Law regarding life jackets if you keep the required number of Coast Guard approved jackets stowed aboard in a place where they are readily accessible. The place where the life jackets are kept should be clearly identified so that everyone aboard will know where it is. Life jackets should fit snugly; if you have children aboard, make sure you have child-size PFDs available

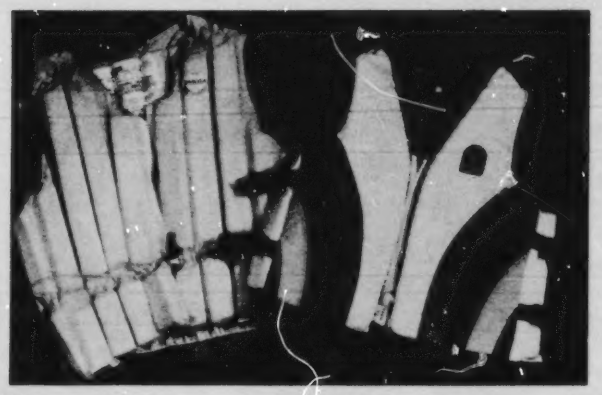
Fig. 3-1. Wearable PFDs

Type I PFD



Type II PFD

Type III PFDs



Type III PFDs

for them. Each life jacket should be stowed with the straps adjusted for the person for whom it is intended, and the fasteners should be left unhooked to save time if the jacket must be put on in a hurry.

Although the law does not require you to wear your life jacket at all times when you are on the water, you should make it a practice to do so. Waiting until conditions on the water get a bit worse before putting it on can be risky. By wearing your life jacket instead of stowing it, you will have immediate use of it in an emergency, and you will also keep it clean and dry. As skipper with responsibility for the safety and well-being of your passengers, you should also urge others aboard your boat to wear their life jackets, and you should insist that any children or nonswimmers aboard do so.

Throwable PFDs. Throwable PFDs (Type IV devices) include buoyant cushions and ring life buoys. (See Fig. 3-2.) The throwable PFD that is required to be aboard most boats as a backup safety device should be stowed topside toward the stern of the craft where it will be immediately available if the need for it arises. A buoyant cushion or a ring buoy can save a life in an emergency, but it should not be regarded as a substitute for a life jacket. Throwables are difficult to catch and hang onto, especially if the water is choppy or if the person in trouble is a child or a nonswimmer.

When throwing a ring buoy or a buoyant cushion to a person who has fallen overboard, you should try to get the device as close as possible to the person without actually hitting him or her with it. If the PFD is a buoyant cushion, make sure the victim does not try to put it on like a backpack; a cushion worn that way will turn the wearer facedown in the water. You may have to maneuver your boat to get in the best position for the rescue effort, and this can present problems. You must act quickly, and if your craft is a sailboat you may lose precious time retrimming the sails to change speed or direction. A motorboat can turn and stop faster than a sailboat, but if it is brought under power too close to the victim, its propeller might inflict serious injury. The best answer to all of the problems associated with throwable PFDs is to make sure that everyone aboard wears a life jacket at all times.

Restricted special-purpose PFDs (Type V devices). A Type V PFD is any PFD approved by the Coast Guard for restricted use in a specific activity. A Type V PFD may be carried in lieu of another type of PFD, but only if the Type V device is approved for the activity in which the boat is being used. Devices approved only for commercial use may not be used for recreational purposes.

Fire Extinguishers

Most motorboats are required to carry fire extinguishers approved for marine use by the Coast Guard or the Underwriters Laboratories. The exceptions are outboard pleasure boats less than 26 feet long that do not have permanently installed fuel tanks or spaces in which flammable or explosive gases or vapors can collect. The number of fire extinguishers that must be carried and their required size depend on the size of the boat. All extinguishers must be in serviceable condition and readily accessible, but preferably not stowed next to common fire sources. (See Fig. 3-3.)

The number of fire extinguishers you must have aboard your boat to comply with the law is the minimum requirement; additional extinguishers provide extra protection. For example, any boat with a galley stove should have a fire extinguisher mounted on a bulkhead adjacent to the galley.

Fig. 3-2. Throwable PFDs (Type IV PFDs)

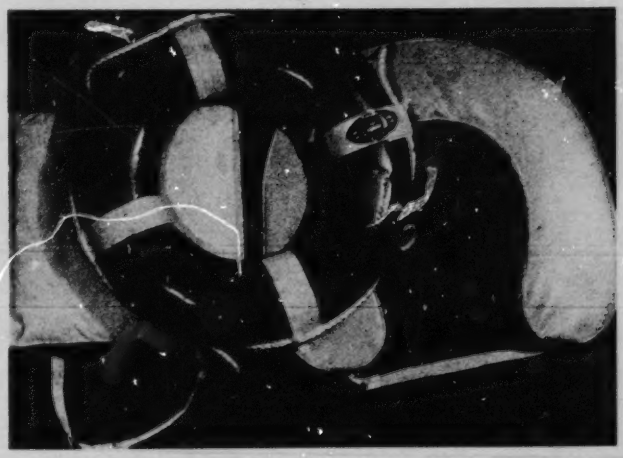


Fig. 3-3. Fire extinguisher on a small boat

Backfire Flame Arresters

If your boat has a gasoline inboard or inboard-outdrive engine, the engine must be equipped with an acceptable means of backfire flame control. The device most often used to meet this requirement is a Coast Guard approved flame arrester securely mounted on the carburetor air intake. (See Fig. 3-4.) A flame arrester is not required on an outboard motor.

Ventilation Equipment

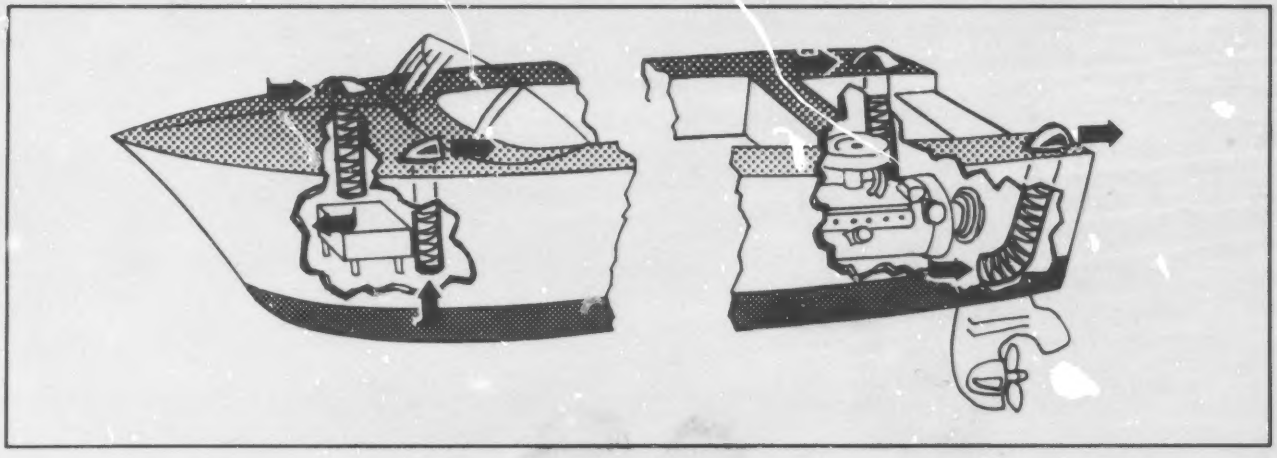
A cupful of gasoline spilled in an open area will ignite readily and make an intense fire; but if the same cupful of gasoline is converted into a vapor in an enclosed space and ignited, it will explode with the force of 15 sticks of dynamite. Taking the comparison a step further, just one tablespoon of gasoline has potentially the same explosive force as one stick of dynamite, which is probably enough to blow you and your boat out of the water. All that is necessary to trigger a gasoline-vapor explosion is a small spark from a light switch or from an electric motor or a discharge of static electricity. For this reason, all gasoline-powered motorboats with enclosed engines and/or enclosed fuel tanks must be equipped with ventilating systems for the removal of explosive or flammable gases from the enclosed compartments.

Except for the natural means of ventilation that comes with a completely open boat, no foolproof system for removing explosive vapors has yet been devised. However, if your boat is required to have ventilation equipment, you can meet the legal requirement with either a passive (wind-powered) system or an active (mechanically powered) system or some combination of the two, depending on the age and constructional features of the boat. In a passive ventilation system, a forward-facing intake cowl catches the wind and directs it down through a flexible duct into the bilge or other enclosed space requiring ventilation. A similar duct extracts the vapor from the enclosed space and carries it up and out of an aft-facing exhaust cowl. (See Fig. 3-5.) Wind blowing over the exhaust cowl creates a slight vacuum, which helps to draw out any accumulated vapors.

A passive ventilation system works well only when the boat is headed into the wind. An active ventilation system is similar to a passive system except that it includes an explosion-proof electric blower or fan that forces fresh air into the enclosed space. The obvious advantage of an active system is that it works even when there is no wind or the boat is not in motion, for example at dockside after refueling. (Most boat fires and explosions occur at dockside during or shortly after refueling.)

Fig. 3-4. Backfire flame arrester

Fig. 3-5. Ventilation system



Lights

All boats that are under way during the hours between sunset and sunrise and during periods of restricted visibility must show required running lights. Lighting requirements vary according to the type and size of the vessel and the waters in which it is operating.

Horns, Whistles, and Bells

Boat operators are required to give prescribed audible signals under certain conditions, for example when fog, mist, snowfall, or heavy rain restrict visibility and when the operator of a powerboat intends to pass, overtake, or cross the path of another such vessel or needs to give warning of imminent danger. Horns, whistles, or bells may be required for this purpose, again depending on the type and size of the vessel.

Distress Signals

Vessels operating on coastal waters are required to carry visual distress signals. For purposes of this requirement, coastal waters include all waters extending shoreward from the ocean, including bays, harbors, sounds, and rivers, to the point where the width between shores is less than two miles. Distress signals provide boaters with effective means of summoning help in an emergency. The correct signal used in the correct way commands immediate attention, and it helps reduce the time required to find a boat in trouble when a search is under way. Visual distress signals approved by the Coast Guard are of three general types: daytime signaling devices; nighttime signaling devices; and signaling devices acceptable for both day and night use. (See *ABCs of the California Boating Law.*) Boats 16 feet (4.88 metres) or more in length must carry three daytime signals and three nighttime signals. The following boats are not required to carry daytime signals, but they must carry nighttime signals when they are operating on coastal waters between sunset and sunrise:

- Boats less than 16 feet (4.88 metres) long
- Boats participating in organized events, such as races, regattas, or marine parades
- Open sailboats not equipped with propulsion machinery and less than 26 feet (7.9 metres) long
- Manually propelled boats

Pyrotechnic and nonpyrotechnic devices. Pyrotechnic visual distress signals include hand-held or pistol-launched red flares; pistol-launched red meteors or parachute flares; and floating or hand-held orange smoke signals. Nonpyrotechnic visual distress signals include orange distress flags and electric distress lights. On boats that must carry both daytime and nighttime distress signals, any combination of pyrotechnic signaling devices is acceptable as long as the devices add up to three signals for day use and three signals for night use. (The requirement can also be met with signaling devices that are approved for both day and night use.) In the case of nonpyrotechnic devices, only one distress flag is needed to meet daylight requirements, and only one electric distress light is needed to meet night requirements. There is no type of signaling device that is ideal for all conditions and all purposes; the best practice is to carry several types. For example, an aerial flare can be seen over a long distance on a clear night, but a hand-held flare may be more useful at closer range.

Hand-held pyrotechnic devices such as flares and smoke signals may expel ash and slag as they burn. Even though these particles cool quickly, they can cause painful burns or ignite materials that burn easily. The flare itself is very hot and can start a fire if it is dropped. If you are using such a device, you should hold it over the water and in such a way that hot slag cannot drip onto your hand. Projectile-type devices such as parachute flares and meteors have many of the characteristics of firearms, and they must be handled with the same caution and respect.

A visual distress signal can only be effective when someone is in position to see it, and if you are in trouble on the water you cannot afford to waste your flares and smoke signals by setting them off indiscriminately. You should only use a pyrotechnic device when you can see or hear a boat or aircraft or are reasonably sure that someone on shore is able to see your signal and take action.

Other kinds of distress signals. Listed below are some other signaling methods that are commonly used by boaters in distress to attract attention and summon help. These signals do not replace those required by law, but they can be very useful in an emergency.

- Signaling with a mirror
- Continuously sounding a foghorn or similar device
- Throwing overboard a dye marker
- Transmitting a "Mayday" radio call
- Flying a "November-Charlie" signal flag from the mast
- Firing a gun at one-minute intervals
- Lighting a fire in a bucket
- Activating an emergency radio beacon
- Displaying any square shape above a round shape (a flag and a ball, for example)
- Slowly raising and lowering both arms outstretched at your sides

Responding to a distress signal. If you see or hear a distress signal, you should go to the aid of the vessel in distress if you can do so without endangering your passengers, and you should as soon as possible notify the Coast Guard or local authorities. The Federal Boat Safety Act of 1971 contains a "good samaritan" sec-

tion which essentially provides that if you freely, in good faith, and in a prudent manner render assistance to a boater in distress, you may not be held liable for any civil damages as a result of rendering the assistance.

Additional Equipment

Besides the safety equipment required by law, a properly outfitted pleasure craft normally carries additional equipment and supplies that contribute in important ways to safe and pleasurable boating. The kinds and amounts of additional equipment that should be kept aboard depend on the type and size of the craft and on the waters on which it will be used. For a canoe or a kayak, the list of recommended but not required equipment may be short—perhaps just a spare paddle if the craft is operated only on sheltered waters, and maybe a patch kit if the canoeist or kayaker is a white-water enthusiast. The list will be much longer for a motor vessel or large sailboat that is equipped for extended cruises.

Tools and Spare Parts

At best, a breakdown in the water is inconvenient, but it can also be dangerous, for example if you are caught out in a remote area where the wind and the weather are becoming threatening. You can keep failures to a minimum by inspecting the equipment aboard your boat and correcting any deficiencies before and after each outing. Look for loose or missing screws and other hardware items, wiring with deteriorated insulation, electrical connections that are loose or corroded, and other defects that you can identify and correct without having to tear down major components.

Since there is always a chance that something will fail while you are out where help may not be available, you should keep aboard a few spare parts and some simple tools that will enable you to make temporary repairs in an emergency. Lack of a fifty-cent shear pin or the means to install it can immobilize a ten-thousand-dollar motorboat. Some other kinds of spare equipment that are important to have aboard a motorboat include spark plugs and other ignition parts, fuses, an assortment of common hardware items such as machine screws, nuts, washers, and cotter pins, and an extra propeller. Extra gas and oil may be kept aboard, but only if properly stowed in safe containers. (You may be able to improvise a replacement for a broken starter cord, but if you run out of fuel the only way to get under way again is with more fuel.) If your watercraft is a sailboat, you should have aboard such spare parts and equipment as screws and other common hardware items, blocks, clevis pins, split rings, sail tape, duct tape, and extra line.

Every boat acquires a history of items that often wear out or get lost, and these parts must be given primary consideration in planning for replacements. Since storage space will probably be limited, you should make a careful inventory of the maintenance and repair needs of your boat and carry aboard only those spares that you are most likely to require in an emergency. (See Fig. 3-6.)

The tools most often needed aboard a pleasure boat are screwdrivers, common and locking-type pliers, box and open-end wrenches in sizes to fit critical equipment, an adjustable wrench, a spark plug wrench, a hammer, and a length of stiff wire for cleaning plugged fuel and fuel-vent lines. (See Fig. 3-7.) You should also have aboard clean rags and any specialized equipment you may need for emergency repairs, such as an outboard-motor manual.

A common item every boater should have is a pocket knife. The need for a knife can be urgent at the site of a boating accident. For example, if a person must be freed in a hurry from a badly tangled line, the line will have to be cut. Synthetic lines in particular are tough and abrasion resistant, so the knife used to cut them must be very sharp.

Knowing how to use standard equipment in nonstandard ways can save the day in an emergency. Under ideal conditions, you would not want to use a

Fig. 3-6. Boating spares kit

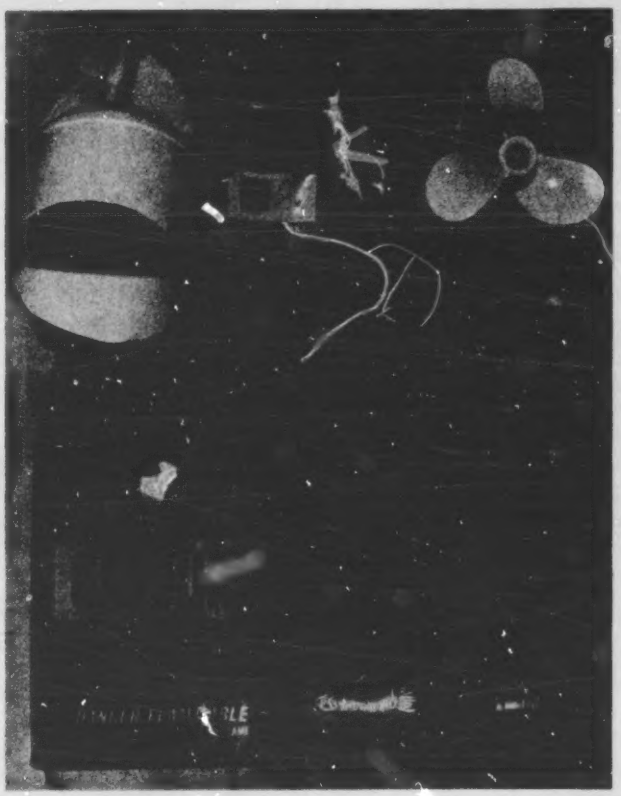


Fig. 3-7. Boating toolkit

screwdriver as a pry bar or use friction tape to mend a leaky hose on a bilge pump, but make-do methods and temporary repairs are justified if they get your disabled boat safely back to shore.

Anchors

Anchors for pleasure craft are manufactured in many styles and sizes. (See Fig. 3-8.) Although they may not look alike, all anchors work in basically the same way and have similar parts, and they all have the same purpose—to hold the craft in a desired location on open water where there is no place to attach a mooring line.

Holding power of an anchor. The anchor you choose for your boat must not only be the right size for the boat; it must also be the right type for the bottom you intend to anchor in (for example, mud, sand, rock, or seaweed). In general, anchors with narrow flukes are best for rocky bottoms, and those with wide flukes are best for sandy or muddy bottoms. The holding power of an anchor is determined by the design of the anchor, not by its weight. An anchor that can be lifted easily by hand will hold a 20-foot (6.1-metre) boat securely, assuming that the anchor is the right type for the bottom and is properly set.

A short length of chain (about 6 feet [1.83 metres]) is commonly connected between the anchor and the nylon or manila anchor line. The nautical term for the anchor line and the attached chain is the "rode." The anchor, the rode, and all the associated rigging are called the ground tackle. The length of the rode is critical for secure anchorage; in calm waters, it should be at least five times the vertical distance to the bottom, as measured from the bow of the boat. This relationship between the depth of the water and the length of the rode is called the scope. If you are dropping anchor to ride out a storm, you should increase the scope to about 10 to 1 (10 feet [metres] of rode for each foot [metre] of water depth). You should also increase the scope somewhat if the bottom is muddy or sandy, since the anchor will tend to bury itself in the soft material. (See Fig. 3-9.)

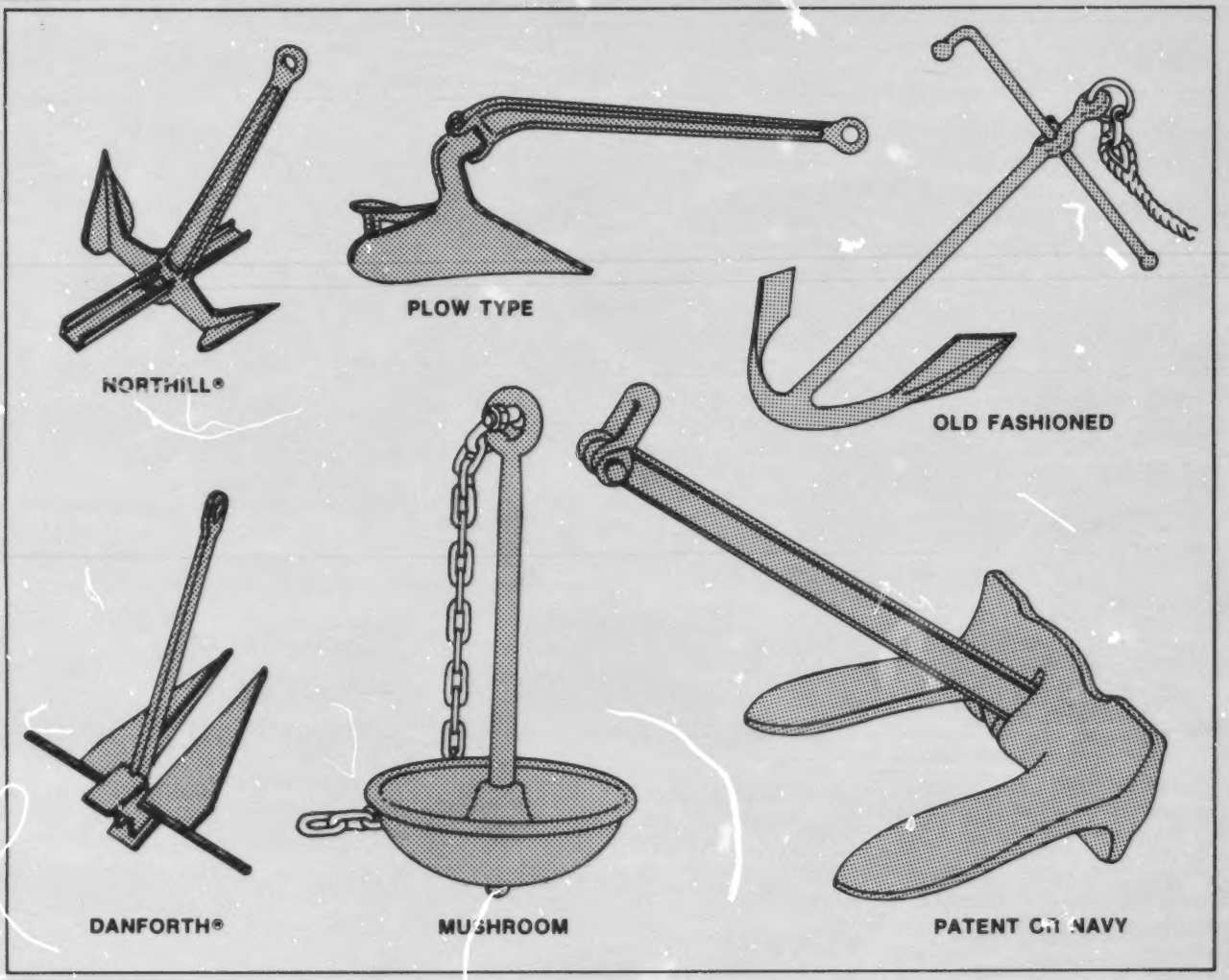
Anchoring. When an anchor is lowered onto the bottom, it comes to rest on its side and begins to dig in. To set the anchor, you should back the boat slowly until you feel resistance in the anchor line, then give the line a sharp tug. (This is also called snubbing the anchor.) If you attempt to set the anchor without first paying out enough line, the force acting on the anchor will tend to be vertical instead of horizontal, and the anchor will pull free rather than dig in. Even if good anchorage is achieved with a short line, the anchor will probably come loose prematurely as a result of the constant movement of the boat. A correctly set anchor on an anchor line with enough scope will stay in place until you pull it free by hauling up on the line.

Many boating accidents are the result of careless anchoring. The anchor should always be lowered onto the bottom, never simply thrown over the side. If a fast-running line on a thrown anchor gets tangled around your leg, you may be pulled overboard with the anchor. To avoid accidents of this kind on your boat, you should always stay clear of the coils or bights of any running line. Also, a thrown anchor may land upside down or with its flukes in the wrong position to get a good bite, and the boat will drag anchor. Another dangerous practice is lowering the anchor (or worse yet, throwing it) without first bringing the boat to a stop. If the anchor grabs while the boat is still under way, the boat will pitch dangerously and may even capsize. (The bow stops, but the stern tends to keep going.)

Anchoring is easier if two persons work together, one controlling the boat while the other lowers the anchor. The procedure for safe anchoring is as follows:

1. Choose your anchoring spot with care, taking into consideration the depth of the water, the condition of the bottom, and the ways in which the anchorage might be affected by the tides. (Before boating in unfamiliar waters, you should check a nautical chart of the area to obtain this information.) If possible, select a sheltered spot away from a leeward shore. Also, maintain a safe distance from other anchored craft.

Fig. 3-8. Anchors

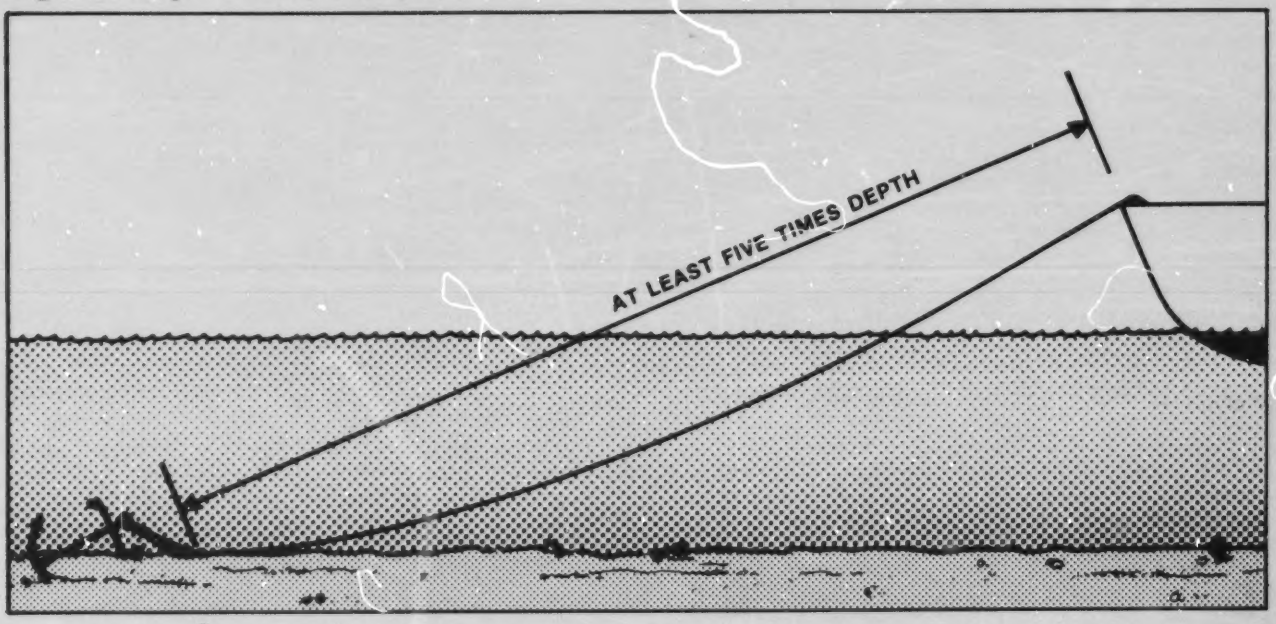


2. Have the anchor and the anchor line ready at hand near the bow. Be sure that the anchor line is fastened securely to the anchor and that the other end of the line (the "bitter" end) is tied to some fixed object on the boat; otherwise, you may pull up a line with no anchor or lose both the anchor and the line.
3. Approach the anchoring spot against the wind or against the current, whichever is stronger, and slow down and stop as you come over the spot. (If your craft is a powerboat, you may have to reverse the engines to lose headway and come to a stop.) Just as the boat starts to drift backward, begin lowering the anchor carefully from the bow.
4. Hand out the correct amount of anchor line (five times the water depth or more). If the anchor line is too short, the anchor may drag rather than dig in, or if it does take hold it may come loose before you want it to.
5. Secure the anchor line to a cleat at the bow.
6. Back the boat slowly away from the anchoring spot until the slack begins to go out of the line; then set the anchor by giving a sharp tug on the line by hand or, if your boat is a powerboat, by giving the engine a short burst of acceleration in reverse. If the anchor will not set, try letting out a little more line.

Weighing anchor. The following are some points to remember when taking up the anchor (weighing anchor):

1. Using the motor or paddles, position the boat over the anchor. Do not pull on the anchor line

Fig. 3-9. Scope of an anchor line



to do this; you may pull yourself overboard. This operation will be easier if there is someone aboard who can maneuver the boat as you approach the anchoring point; this will free you to haul in the anchor line, and when the line becomes vertical, you will know that you are directly over the anchor.

2. Stop the boat directly over the anchor, and pull straight up on the line to free the anchor.
3. If the anchor will not come free, secure the anchor line to a cleat on the bow, then run the boat in wide, slow circles with the anchor line taut; this should free the anchor. Take care in using this procedure, however; it can be dangerous if the water is not calm.
4. As the anchor approaches the surface, swing it gently to wash it. Be careful not to hit the side of the boat in doing so.
5. Stow the anchor and line in a safe place where the line will dry out and not tangle. That way, the anchoring gear will be ready for its next use.

Lines and Knots

To a boater, "rope" is the material used to make "line." Rope becomes line when it has been cut from the coil for a specific use. Lines are used for many purposes aboard watercraft and at dockside, and they are called by many names. The names for lines, like many other boating terms, are often unusual-sounding and of obscure origin—for example "rode," the traditional name for an anchor line. To help you become familiar with sailor's language, a glossary of nautical terms is included in the back pages of this book. Many of the reference publications listed in the back pages also contain useful glossaries.

Some types of lines. The lines that are used to secure the bow and stern of a boat to a dock or other moorage are called mooring lines (or bow lines and stern lines). Short mooring lines on the bow and stern of a rowboat or other small craft are sometimes called painters. Besides serving as a mooring line, the bow line is useful for gaining control of a boat that is adrift and being pushed around by wind, current, or wave action; a person who is able to approach the boat can steady it by grabbing the bow line, which then can be used as a towline if necessary.

The permanent lines used to secure the mast of a sailboat are called shrouds and stays, and the movable lines used to trim the sails are called sheets (for example, mainsheets and jib sheets). Permanent lines on a sailboat are called standing rigging; movable lines are called running rigging.

Knots. Every sailor who applied for a berth on an old-time clipper ship was expected to be skilled in "marlinspike seamanship," the art of handling and caring for line and tying knots. As the skipper of a modern pleasure boat, you must know how to use and care for line, but you need not be an expert in all aspects of knot-tying; the few common knots, hitches, and bends shown in Fig. 3-10 will meet most of your requirements. Each knot shown has its own special uses, but when tied correctly and used for the right purposes, each one holds fast and is easy to untie, even when wet. You should learn the names of these useful knots, and

you should practice tying them until you can do so as easily as you tie your shoelaces.

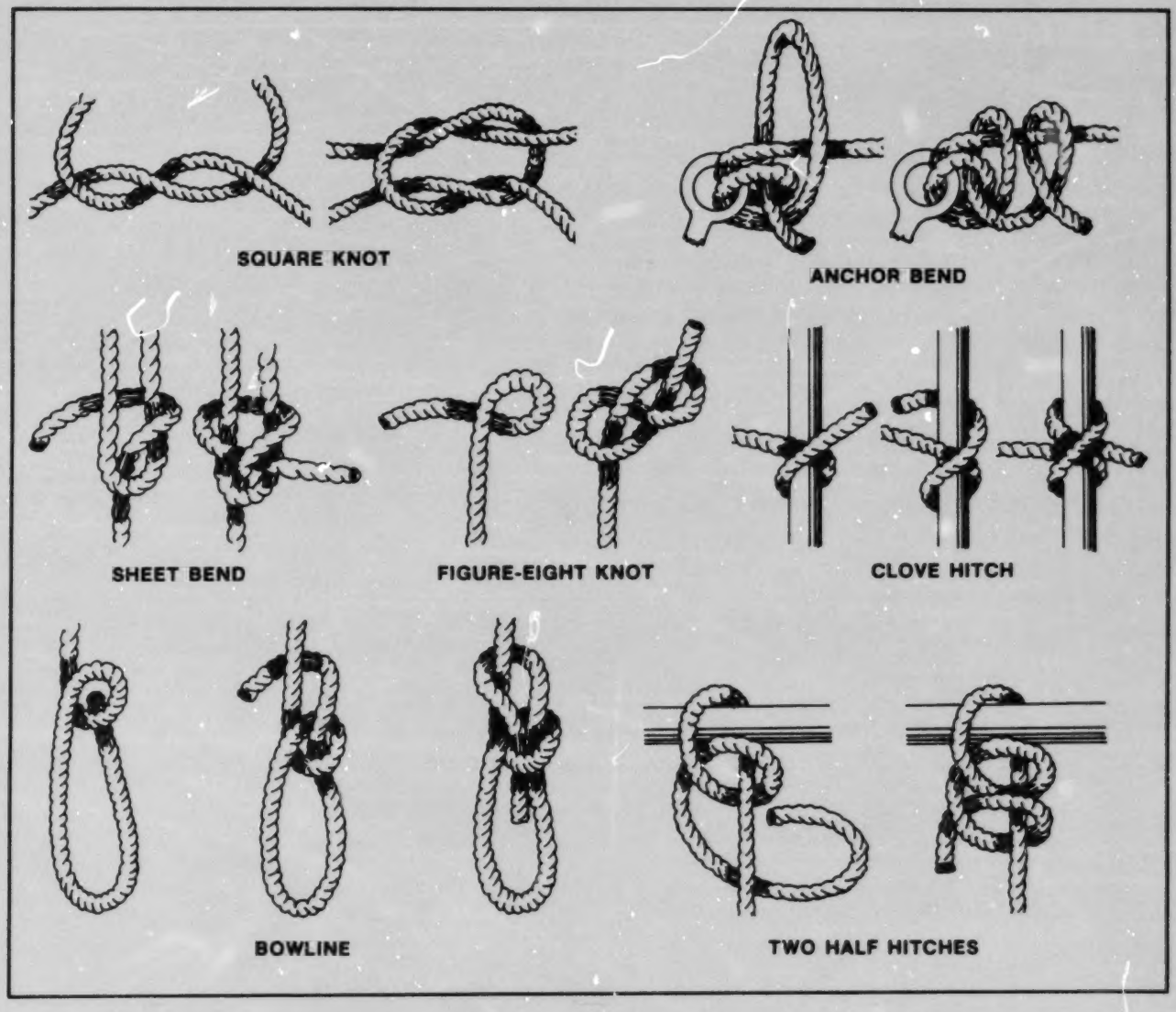
The square knot is a general-purpose, light-duty knot that is especially useful for tying up bundles or reefing sails. A square knot is easy to tie, but if you make the final loop in the wrong direciton, you will end up with a weak granny knot. A square knot should not be used to tie two lines together, especially if the lines are of unequal diameter; the knot will slip or jam if the lines are put under a heavy load. A better knot for this purpose is a sheet bend.

The bowline knot (commonly called just a bowline, and pronounced "BO-lin") is used to make an eye or a fixed loop at the end of a line. A bowline will neither jam nor slip. When using a bowline to secure a mooring line, most boaters tie the knot in hand, then slip the loop over the mooring post. If you pass the other end of the line through the eye of the bowline, you will have a running noose or a lasso.

The half hitch consists of a single loop passed around the standing part of a line (the working part of the line), with the free end of the loop tucked under. One or two half hitches are often used to finish other knots and make them more secure. Two half hitches used alone make a quick and dependable knot for tying a mooring line to a dock for a short stay.

The clove hitch is another fast hitch that is often used for temporary mooring. For added security, the clove hitch may be finished with one or two half hitches.

Fig. 3-10. Some common boater's knots



The anchor bend (also called a fisherman's bend) is commonly used to fasten a line to a ring or an anchor. A half hitch is part of this knot, and a second half hitch is often added as shown in the drawing for extra security.

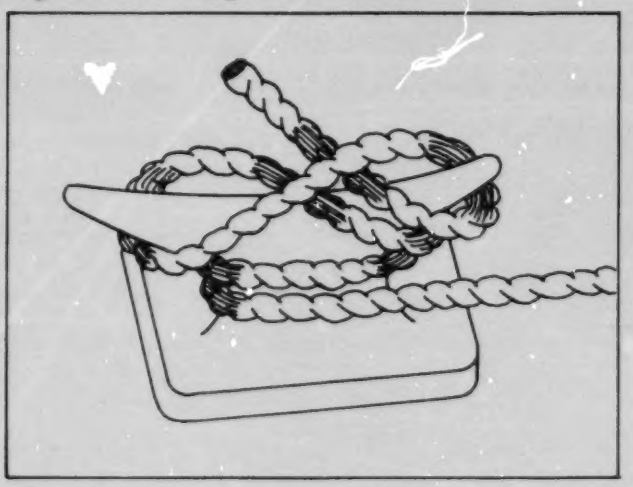
The figure-eight knot is used mainly as a "stopping" knot to keep the free end of a line from running out of a block (the nautical term for a pulley).

Making fast (tying up) to a cleat. If a mooring line is incorrectly tied to a cleat, the constant motion of the boat will either work the line loose or jam it so tightly around the cleat that it will have to be cut free. The right way to make fast a line to a cleat is shown in Fig. 3-11. The steps are as follows:

1. While keeping the slack out of the standing part of the line, bend the free end a full turn around the neck of the cleat.
2. Bring the free end of the line up and over one horn of the cleat, and continue with another loop around the opposite horn.
3. Bring up the free end of the line again, and make a reverse loop in your hand.
4. Slip the loop over the first horn of the cleat, and draw the loop tight.

Lines are found on even the simplest watercraft. Sailboards, for example, usually have a safety line or "leash" that prevents the mast and sail from drifting away if they become separated from the hull in a spill. Most of the lines boaters use are made of natural- or synthetic-fiber rope, although wire rope is sometimes used for lines that must bear high-stress loads—shrouds and stays, for example. The materials most often used to make natural-fiber rope are manila, hemp, jute, cotton, and linen; most synthetic rope for marine use is made of nylon or Dacron. Synthetic rope has some characteristics that make it popular for marine use. It maintains its strength when wet, and it does not rot, mildew, or deteriorate from exposure to sunlight. Synthetic rope also has about twice the tensile strength of manila rope of comparable size, and it is lighter, smoother, and more pliable than most natural-fiber rope. Nylon rope stretches more than Dacron or manila rope under a load; this makes it a good choice for lines that must absorb shock, such as anchor lines and towlines, but Dacron or manila rope is better suited for shrouds, stays, sheets, and other rigging lines.

Fig. 3-11. Making fast to a cleat



The ends of a cut line must be finished in some way to keep the strands from raveling. On natural-fiber line this is accomplished by binding the cut ends with whipping twine. The cut ends of a synthetic line can be finished by melting the fibers together with the flame of a small torch or even a match.

Lines of every type should be kept free of mud, dirt, and grease, and when not in use they should be coiled and stowed in a dry, well-ventilated place.

Oars and Paddles

Oars and paddles are essential equipment for manually powered watercraft, and a paddle is a useful item to have aboard your motorboat or sailboat. In the event of a power failure, you can use the paddle to make some headway and maneuver out of tight spots. Some common types of oars and paddles are shown in Fig. 3-12.

Oars for rowboats and dinghies are generally made of ash or spruce. Ash oars are heavier than spruce oars and can withstand rougher use. For best handling, the balance point of an oar should be from 8 to 12 inches (20.3 to 30.5 centimetres) outboard from the oarlock, depending on the length of the oar. This will make the oar slightly heavy on the blade end, but if it is properly balanced you should be able to keep it clear of the water on the return stroke with just the weight of your hand.

Paddles for canoes, kayaks, and other paddle craft may have a single blade or a blade at each end. Single-blade paddles are more common, but double-blade types are often chosen for solo cruising, especially in white water and for paddling against wind and waves. The blades of a double-blade paddle may be either flat or curved, and they may be in the same plane or set at right angles to each other; most users prefer the type with curved and right-angled blades. Paddles are commonly made of spruce or some other soft wood or of aluminum and fiberglass.

Bailers

Water may accumulate in a boat from rain, spray, splashing waves, or seepage. Water in the bilge not only looks and smells bad; it also promotes rot and damages equipment, and if it is allowed to build up, the boat may become unstable and hard to handle. A

boat with a lot of water in the bilge might remain afloat in calm waters, but heavy wave action would probably capsize it. Good boating practice requires that the bilge be kept dry or nearly so, and several methods are used to accomplish this. A scoop, bucket, or similar bailing device may be kept aboard a small boat that has storage space for it, but almost anything can serve as a bailer in an emergency—even the boater's cupped hands, if nothing better is available. Cloth buckets can be purchased that fold flat for easy storage. An efficient, lightweight bailer can be made by cutting off the bottom of a plastic bottle or jug (for example, a bleach bottle) to form a scoop. A light line tied to the handle of the bottle and to a convenient point on the boat will keep the bailer in place until it is needed. A sponge is useful for removing small amounts of water than cannot be reached with the bailer.

Hand-powered or electric bilge pumps remove water much faster than hand bailers. Bilge pumps for small boats are usually hand-powered types, either portable or permanently installed. Larger vessels are commonly equipped with electric bilge pumps. On some boats a float-actuated switch turns on the pump when water is present in the bilge; on others, the float switch merely energizes a bilge-water alarm.

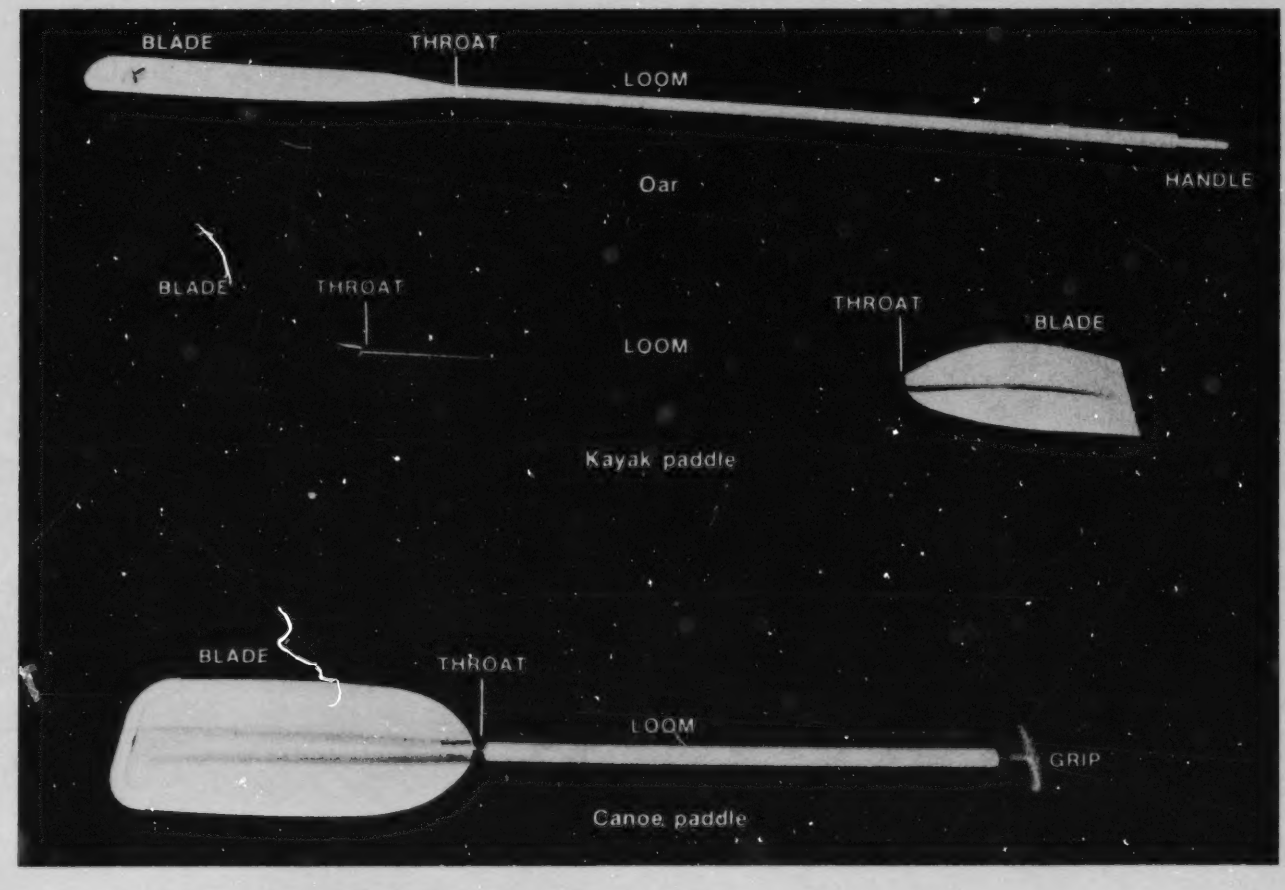
Electric pumps can remove water faster than manual pumps, but pumping stops if the vessel's electrical system fails. A boat with an electric bilge pump should have aboard a backup bailer of some type.

Compass

Although you are not required by law to have a compass aboard your boat, you should install one and learn how to use it. You will consider the small cost of your compass well repaid the first time you use the instrument to find your way back to port through dense fog, in darkness, or in unfamiliar waters. In time, you will learn to respect your compass as much as you do your life jacket, and for many of the same reasons. Like a life jacket, a compass can give you a feeling of confidence when you are far from shore, and at some time it may save your life.

On an ordinary pocket compass, a magnetized needle is balanced on a pivot above a fixed dial on which are marked the compass directions. The needle aligns itself with the earth's magnetic field and points to mag-

Fig. 3-12. Oars and paddles

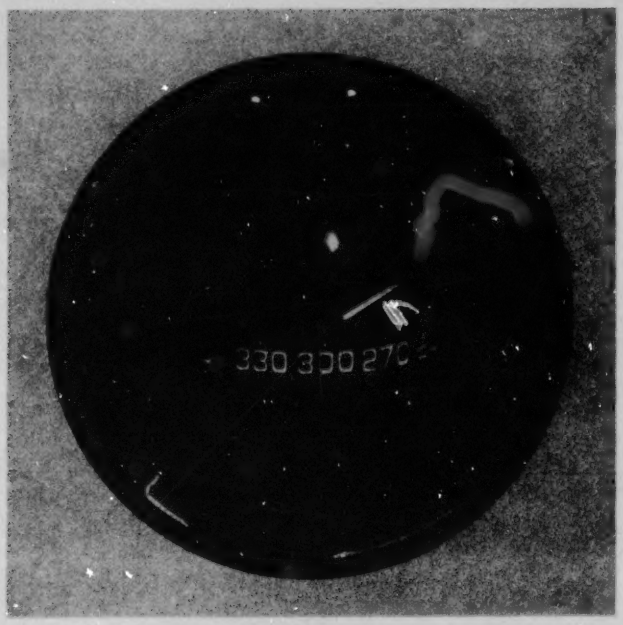


35 BEST COPY

netic north, and if the case is turned so that the *N* on the dial is directly under the pointer, all the headings on the dial will be in the correct relationship to magnetic north. On a marine compass, a pivoting compass card takes the place of the needle. The card is free to turn within the fluid-filled case of the instrument, and a magnet attached to the underside of the card keeps it aligned with magnetic north. An engraved line (lubber's line) on the housing of the compass serves as an indicator; as the boat changes direction, so does the body of the compass and with it the lubber's line, but the compass card remains in its original position because of its attraction to magnetic north. (See Fig. 3-13.)

Using the compass. The card of a marine compass is marked in degrees as well as in the principal compass points. On some small compasses the final zero is dropped from the degree numbers to conserve space on the card; thus the number 6 may mean 60 degrees, and the number 20 may mean 200 degrees. If the lubber's line on your compass is on the zero-degree mark or *N*, your boat is heading north (magnetic north, not geographic north, and disregarding for the moment any other needed corrections). If you wish to change your course and head due east, turn right until the 90-degree mark (*E*) on the compass card lines up with the lubber's line. Continue the turn another 90 degrees (to the 180-degree mark) to head south, and another 90 degrees beyond that (to the 270-degree mark) to head west. If you continue the turn for a final 90-degrees (back again to zero), you will be heading north again. At the end of the maneuver, you will have turned 90 + 90 + 90 + 90 degrees, or 360 degrees.

Fig. 3-13. Compass



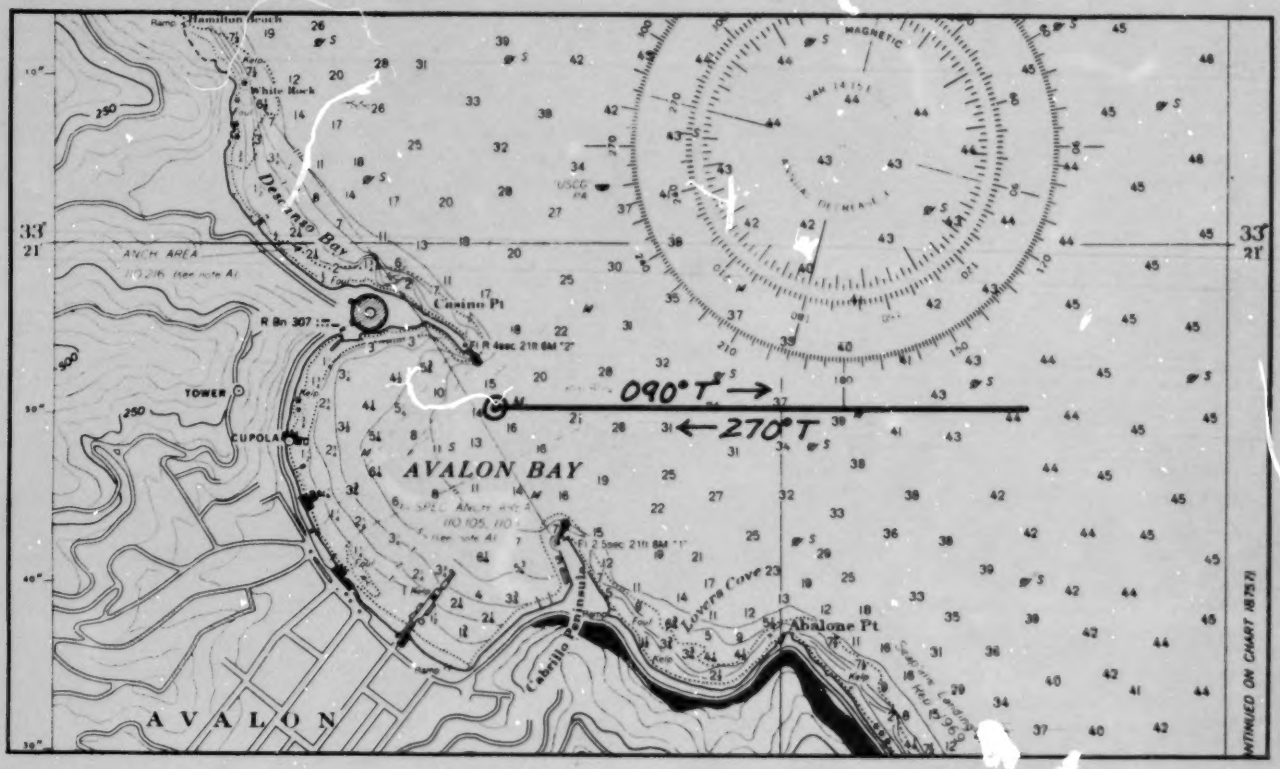
A full-circle turn is always 360 degrees, regardless of the compass heading at which you start and end the turn. Similarly, a half turn is always 180 degrees, so to reverse your direction and find your way back to port when you have been on a straight-line outbound course, use the compass to make an accurate 180-degree turn. To determine the new compass heading for the return trip, either add 180 degrees to the outbound heading or subtract 180 degrees from it, whichever method results in a number that does not exceed 360 (since there are only 360 degrees on the compass card). For example, if the outbound heading was due east (90 degrees), the return heading would be 270 degrees (90 + 180 degrees); if the outbound heading was due west (270 degrees), the inbound heading would be 90 degrees (270 – 180 degrees). The example given does not take into account the effect of such variables as wind drift, current drift, and compass error, but it does illustrate an important use of the compass. (See Fig. 3-14.)

Compass deviation. If a compass is installed near an object made of steel, iron, or some other magnetic material, or if it is close to a radio speaker, a wire that carries direct current, or some other piece of electrical or electronic gear that produces a magnetic field, the compass heading will deviate to some extent from the true magnetic heading. The adjustable compensating magnets included in most compasses will enable you to correct minor deviation errors, but to keep deviation problems to a minimum you should mount your compass where it is least affected by magnetic materials and stray magnetic fields.

Magnetic variation. The earth's magnetic north pole is located about 1,000 miles (1 609 kilometres) away from the geographic north pole, in a group of islands just above Canada at approximately 75 degrees north latitude and 100 degrees west longitude. Since a compass needle or card seeks magnetic north and not geographic or true north, compass headings differ from true headings by an amount that varies from location to location. The difference between magnetic north and true north is known as magnetic variation. To chart an accurate course with respect to true north, you must correct for the amount of magnetic variation in the area where you will be boating. You can do this by consulting a nautical chart for the area. The chart will include a "compass rose" that consists of two concentric rings marked in degrees. The zero-degree or north mark on the outer ring points to true north, and the same mark on the inner ring points to magnetic north. The difference between the two headings is the magnetic variation for that location. (See Fig. 3-15.)

Magnetic variation is not a constant quantity; it changes slightly with the passage of time, and the rate

Fig. 3-14. Figuring a return course

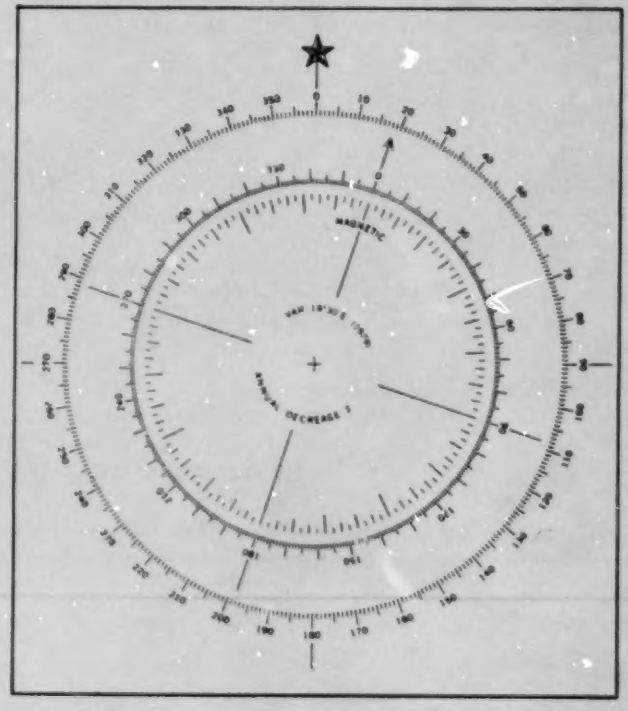


and direction of the change are different for each location. The variation shown on a compass rose was correct at the time of publication of the chart, but to bring it up-to-date you need to figure in the annual change shown near the center of the rose.

The effect of compass errors. Compass headings are subject to error from deviation, magnetic variation, mechanical faults such as a sticky card or a loose or improperly adjusted compensating magnet, and misreading of the card. Reading the card of a small compass can be difficult, especially in rough water. The card will probably be in motion when you want to check your heading, and since the interval between graduations on the card may be as much as 10 degrees, you may have to "read between the lines" to get a reasonably accurate bearing.

Errors of a few degrees are common with small compasses, and while a minor error of this kind might not be significant on a short run, it could take a boat many miles off course on a long trip. Like the rest of your boating equipment, your compass should be the right kind for the type of boating you expect to do. An inexpensive compass with a 2-inch (50.8-millimetre) card might be adequate for a small runabout that is used only within sight of shore, but a larger boat intended for long, offshore cruises should be equipped with a larger and more accurate instrument.

Fig. 3-15. Compass rose



BEST COPY

Nautical Charts

Before venturing into unfamiliar waters or beginning any trip that requires navigation, you should obtain and study a nautical chart for the area. When used in conjunction with your compass, the chart will enable you to establish an accurate course and maintain correct headings throughout the trip. The principal source of nautical charts is the National Ocean Survey (NOS), an agency of the U.S. Department of Commerce. A portion of an NOS nautical chart is shown in Fig. 3-16. You should be able to get an up-to-date chart for the area where you intend to boat at any nearby marine store.

Features of nautical charts. Nautical charts contain detailed information regarding water depths, hazards above and below the water, the characteristics of the bottom, and the locations of navigational aids and identifiable landmarks. (Note the compass rose showing magnetic variation on the chart in Fig. 3-16.)

Charts are made in several different scales for a variety of uses. The scale of a chart is the relationship of the drawing dimensions to the actual dimensions of the depicted area, expressed as a ratio. A small-scale chart is used to depict a large area; a large-scale chart is used to depict a small area. The chart shown in Fig. 3-16 is drawn to a scale of 1:40,000, or one foot (metre) equals 40,000 feet (metres). Charts used to show the specific features of a relatively small area, such as a harbor or a channel, may be drawn to an even larger scale (1:20,000 or larger). The sailing charts used for offshore navigation over long distances are drawn to a very small scale, typically 1:1,200,000.

Using a chart and a compass to establish position. Distances are deceiving on the water, and you may find it difficult to establish your position by just estimating the distances to a couple of identifiable landmarks. A better method when you are within sight of shore involves the use of your chart and compass and a pencil and straightedge, as follows:

1. Visually locate at least three widely separated landmarks, lights, or other navigational aids that are also shown on the chart.
2. Using your boat compass or a hand-held compass, take a bearing on one of the sighted objects. Locate the object on the chart, and using the straightedge, draw a line extending from the sighted object in the reverse direction of the compass bearing. Use the compass rose on the chart to align the straightedge with the compass bearing.
3. Repeat step 2 for the remaining landmarks. The place on the chart where the bearings cross is your position.

Radiotelephone

If it is practical to do so, you should consider equipping your boat with a radiotelephone. Modern solid-state units are compact and require very little power, and they can therefore be used on almost any small boat that has an electrical system. (See Fig. 3-17.) Having a radiotelephone aboard is more than just a convenience; the primary purpose of the instrument is safety. If you are in trouble on the water, your radiotelephone can make it possible for you to get help in a hurry.

A shipboard radiotelephone is actually a miniature radio station, and as such it is subject to the regulations of the Federal Communications Commission (FCC). FCC regulations govern the frequencies that can be used for radiotelephone communications, the format and content of the communications, maximum allowable transmitter power, and operating procedures for the equipment.

To ensure best use of the instrument as a marine safety device, the FCC requires that whenever a radiotelephone is turned on and is not being used to transmit or receive on another frequency, it must be kept tuned to the calling and distress frequency (either 2182 kHz or 156.8 mHz, depending on the band of frequencies being used). Mariners call this "keeping a listening watch." A listening watch is maintained not only on other pleasure boats and merchant ships that are equipped with radiotelephones, but also by Coast Guard personnel in patrol vessels and at shore stations.

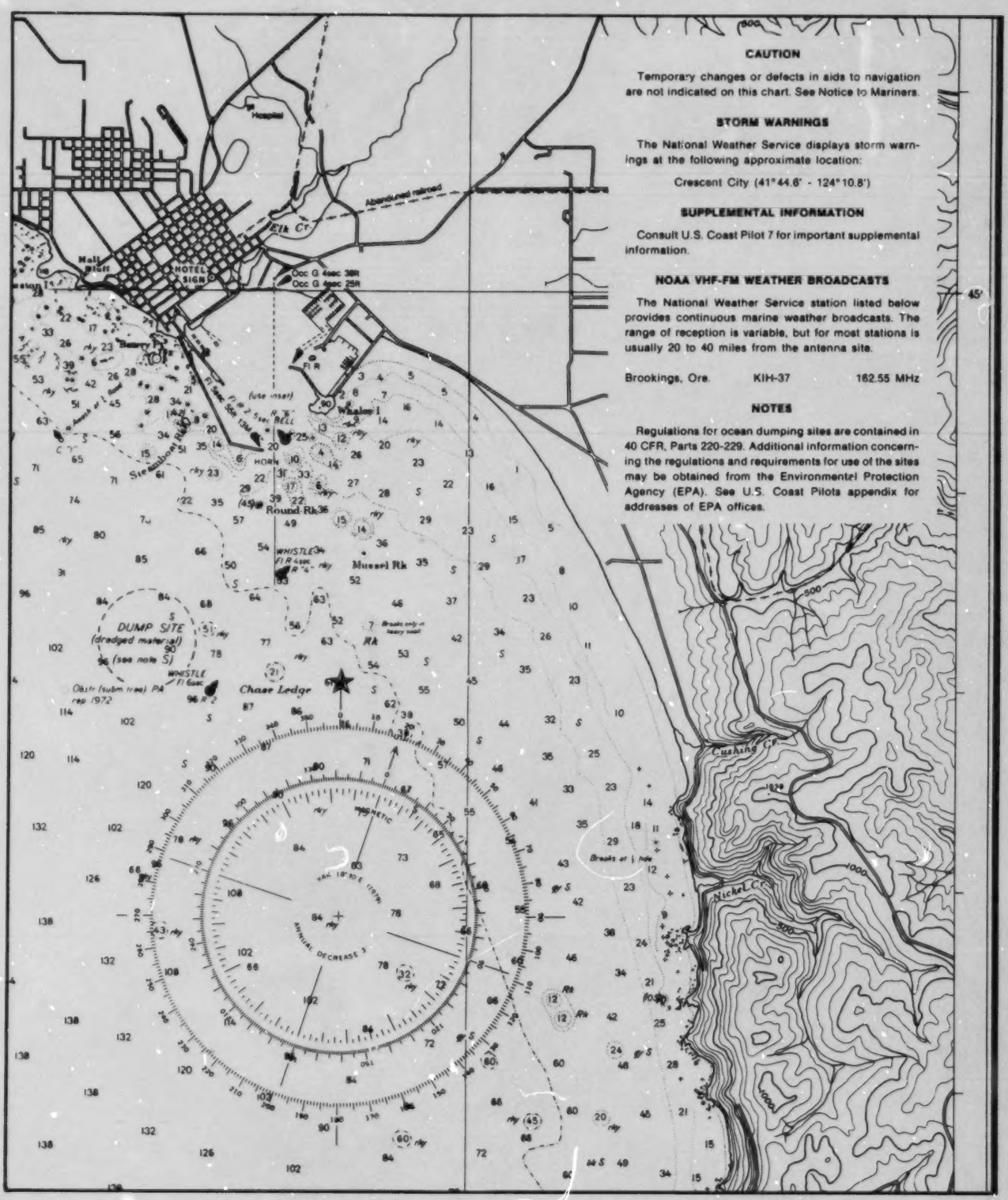
Owning a radiotelephone makes you part of an extensive marine communications network, and you can be almost certain that at whatever time of the day or night you broadcast a call for help, someone will respond and come to your aid. You will also be able to summon help for other boaters who are in trouble but who do not have a radiotelephone.

Common sense and common courtesy require that before you transmit on any frequency, you should listen awhile to make sure no one else is using that channel, and especially that no one is using it to transmit a safety or distress message. Distress calls always have priority over other transmissions, and a boater who is in grave and imminent danger may break into any routine communication on any channel by making a "Mayday" call in the manner prescribed by FCC regulations. (An informative discussion of marine radiotelephones and the rules that govern their use is contained in the U.S. Coast Guard Auxiliary publication *Boating Skills and Seamanship*.)

Other Electronic Equipment

The radiotelephone is probably the most important piece of electronic gear you can have aboard your pleasure boat. However, you may also want to investigate some of the other sophisticated electronic devices that

Fig. 3-16. Portion of an NOS nautical chart


CAUTION
Temporary changes or defects in aids to navigation are not indicated on this chart. See Notice to Mariners.
STORM WARNINGS
The National Weather Service displays storm warnings at the following approximate location:
Crescent City (41°44.6' - 124°10.8')
SUPPLEMENTAL INFORMATION
Consult U.S. Coast Pilot 7 for important supplemental information.
NOAA VHF-FM WEATHER BROADCASTS
The National Weather Service station listed below provides continuous marine weather broadcasts. The range of reception is variable, but for most stations is usually 20 to 40 miles from the antenna site.
Brookings, Ore. KIH-37 162.55 MHz
NOTES
Regulations for ocean dumping sites are contained in 40 CFR, Parts 220-229. Additional information concerning the regulations and requirements for use of the sites may be obtained from the Environmental Protection Agency (EPA). See U.S. Coast Pilots appendix for addresses of EPA offices.
DUMP SITE
(dredged material)
(see note S)
Chase Ledge
Round Rk
Mussel Rk
Whaler I
Crescent City
Abandoned railroad
Elk Cr
Nickel Cr
Cushing Cr
45'
500
1000

BEST COPY

Fig. 3-17. Marine radio telephone

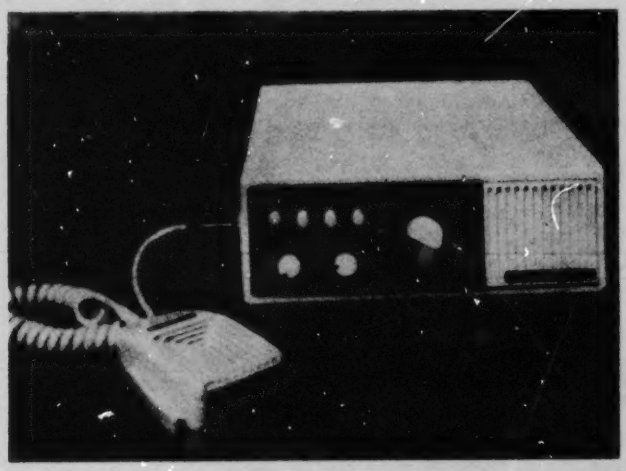


Fig. 3-18. Radio direction finder

have been developed to make boating safer and more pleasurable. If your craft is a powerboat, it may already be equipped with an electronic fume detector or an electronic tachometer, and its engine may have an electronic ignition system. Depending on the type, size, and cruising range of your boat and the amount of money you are willing to spend, you may want to invest in a radio direction finder or an omni (a more complex and expensive type of radio direction finder), a depth finder, or even radar or loran equipment. Not many owners of small pleasure boats need or can afford radar or loran, but a growing number are buying radio direction finders and depth finders.

Radio direction finder. Radio direction finders (RDFs) work by identifying the direction from which a radio station is broadcasting. In its simplest form, an RDF is just a portable, multiband radio with a rotatable bar-type antenna mounted on an azimuth scale that is marked in degrees. When the antenna and azimuth scale are turned so that the signal from a station of known location is weakest (the null position), the bar antenna will be pointing in the direction of the station, and the reading on the azimuth scale can then be converted to a compass bearing. (But you must be sure you are reading the correct null and not its reciprocal, which will be 180 degrees away on the azimuth scale; use your compass and your chart to identify the correct null.) By taking readings from two or more stations whose locations can be found on a chart, you can determine your position by drawing intersecting lines on the chart, as described earlier in this chapter. A typical marine RDF unit is shown in Fig. 3-18.

Although any commercial AM radio transmitter of known location within range of your RDF can be used as a signal source, better and more reliable signals are available from U.S. Coast Guard marine radio beacons.

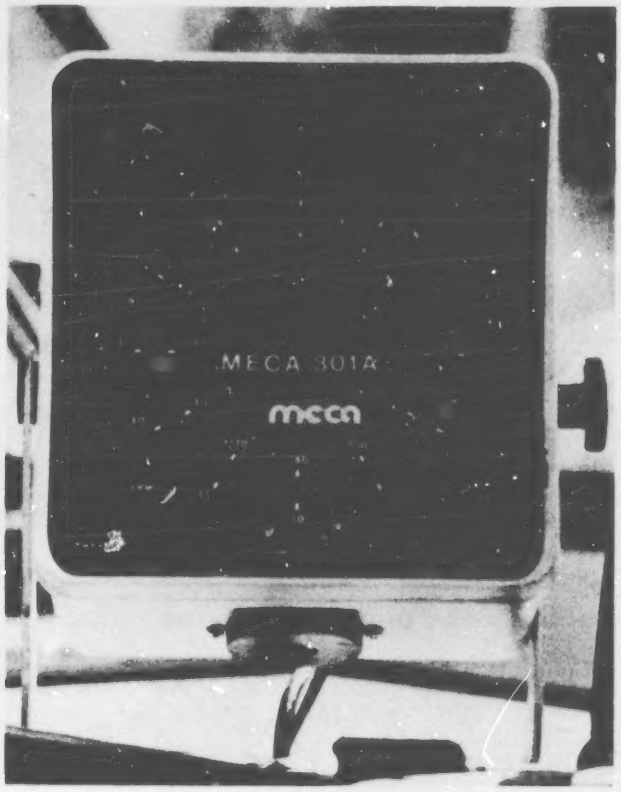
Depth finder. An electronic depth finder (also called a fathometer or an echo sounder) works by measuring the time it takes for a series of ultrasonic pulses to reach the bottom and return to the instrument's transducer, which both sends and receives the pulses. A long cable connects the hull-mounted transducer to the depth indicator instrument in the cabin. Circuitry in the instrument converts the measured time interval into feet or fathoms and displays that information on a panel meter or digital readout device. Some depth finders include an audible alarm that warns of shallowing bottoms. (See Fig. 3-19.)

A depth finder can keep your boat from running aground on a shoal or reef, and it can also serve as a navigational aid. You can confirm your position, for example, by comparing the depths shown on the chart with the soundings indicated on the depth finder. You can also use the instrument to stay within the navigable portion of a narrow channel or to run safely along the edge of a dredged channel in a fog. In the latter case, by navigating near the edge of the channel, you will stay at a safe distance from larger vessels whose deeper draft keeps them farther out in the channel.

Protective Clothing

Summertime is the peak season for recreational boating, and part of the fun is swimming off the boat and just relaxing in the sunshine. A swimsuit is appropriate—most would say essential—for swimming and sunning, but unless it is worn with additional clothing, it is not a good choice for boating. Swimwear provides freedom of movement, but it will not keep you warm or give you much protection against sun, wind, and water or from injury due to accidental contact with parts of the watercraft. You should select your boating outfit for comfort as well as for protection against the elements. In a mild, sunny environ-

Fig. 3-19. Depth finder



ment where the water is warm and calm, you may only need protection against sunburn. Cotton clothing is usually adequate for this purpose, and since it allows your body to "breathe," it is also very comfortable on a hot day. Wool clothing is a better choice in a cooler environment; the thickness of the fabric and the air spaces between the wool fibers provide good insulation, and insulation is the key to warmth in water activities.

To stay warm in cool weather, you should avoid loose clothing that allows air to circulate next to your skin and carry off body heat. Warm air can escape through open collars, loose-fitting sleeves and pant legs, and shirts worn outside the pants. When that happens, your body must work harder and burn extra calories to maintain its normal temperature, and in doing so it uses energy you might need for other kinds of activity.

Keeping warm if you get wet. A wool garment can keep you warm even if it gets wet; moisture trapped in the fabric is warmed by your body and tends to prevent further heat loss. You must, however, protect the wet garment from even a gentle breeze by putting on some kind of a water-resistant windbreaker over it. Otherwise, you will lose heat through evaporative cooling.

A wool garment can also provide some protection against loss of body heat if you fall into cold water, but if you are boating where this could happen you should be wearing a wet suit. A wet suit is a close-fitting, synthetic-rubber garment with a fabric or foam liner. Any water that gets past the rubber outer shell is absorbed by the liner, and the wet liner conserves body heat in much the same way as a wet woolen garment. The wet suit also protects against heat loss by keeping your body from direct contact with moving water. (See Fig. 3-20.)

Fig. 3-20. Wet suit

The layer approach to boating wear. During a typical day on the water, you will probably have to make several changes in your boating attire to stay comfortable as the temperature and weather conditions change. If your boat is large enough, it may have a clothing locker, but finding a place to store a lot of extra clothing on a small boat can be a problem. A good solution is to use the layer approach when planning your boating outfit; it will enable you to make maximum use of just a few garments worn in various combinations, and it simplifies storage requirements. (A waterproof bag will usually do for garments not in use.)

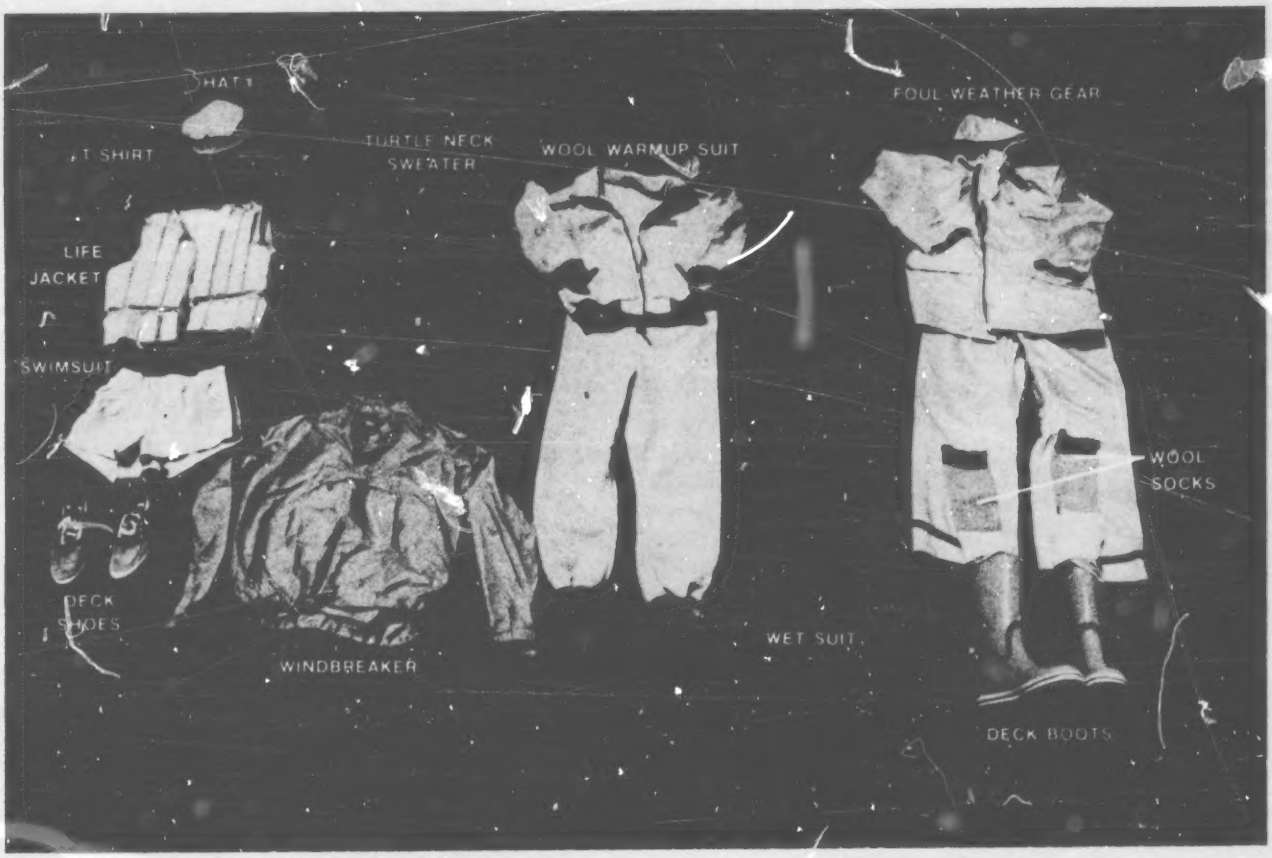
The first layer of your boating outfit may be a light undergarment or even a swimsuit. On a hot day, the second layer may be almost any light- to medium-weight clothing from your wardrobe that will provide protection against sunburn and allow air to circulate. However, if there is any chance that the weather will turn chilly or that you will be out on the water after dark, you should keep in reserve some warmer clothing, preferably wool pants and a long-sleeved wool shirt, and perhaps a wool sweater. For greater warmth, the second layer can be wool longjohns, followed by wool outergarments as the third layer; or you can complete your boating outfit with just a wet suit. (See Fig. 3-21.)

A wet suit provides both warmth and protection against the elements, but unless you plan to keep it on all day or wear it over a swimsuit, you will need to have some regular outerwear in your clothes locker or garment bag. One precaution about wet suits: if you will be sitting or kneeling much of the time in your watercraft, you should protect the suit in some way from direct contact with nonslip surfaces, which can rub through the rubberized fabric in a short time. Sitting or kneeling on a buoyant cushion or a folded blanket will do.

If you are boating on a windy day and are not wearing a wet suit, you will probably want to wear or have aboard a nylon windbreaker. Extremely windy and wet conditions may call for foul-weather gear.

Life jackets. Regardless of what else you may choose to wear aboard your watercraft, your outfit should always include a life jacket. Novices in boating sometimes ignore this rule; experienced boaters never do. The buoyancy provided by your life jacket is especially

Fig. 3-21. Typical boating clothing



important if you are wearing several layers of heavy clothing. A wet suit alone provides a small amount of buoyancy, but not enough for safety; you should always wear a life jacket over your wet suit. Sailors often wear a large T-shirt over the life jacket to help hold it in place and keep it from getting snagged on rigging.

Footwear. No single type of footwear is ideal for every boating use. The popular canvas sneaker or deck shoe is light and comfortable. It also withstands constant wetting and dries quickly, and it provides good traction without marring varnished surfaces. However, sneakers give your feet little protection against cuts and bruises, and they do not keep them warm and dry, which is essential for your overall comfort. Rubber boots are a better choice for foul weather wear.

A type of footwear preferred by many canoeists and other small-craft operators is the wet-suit bootie. Booties keep your feet warm and provide good traction, but they cannot withstand much heavy use, such as frequent landings on gravel or rocks.

Protection against the sun. Overexposure to the sun is a common boating hazard. It can result in heat exhaustion and heatstroke as well as sunburn. Since there is not likely to be much shade available aboard your watercraft, you must provide your own shelter against the sun by wearing appropriate clothing. Pants and a shirt with long sleeves will protect most of your body against sunburn, but you should also wear a sunhat or cap and some kind of footwear. (Sunburned feet can be painful, especially later when you try to put on your shoes.) Sun-screening and sun-blocking creams and lotions are useful for protecting your face, neck, and other exposed parts of your body against sunburn, but you must remember to reapply them after you have been swimming or perspiring heavily. Also, be sure the product you are using is formulated to give protection against extreme exposures; some are merely tanning agents.

Sunburn can occur even on a cloudy or overcast day; it is caused by the sun's ultraviolet rays, which are relatively unaffected by atmospheric conditions that tend to block the sun's visible light. The danger of sunburn is especially great in a water environment because water reflects and intensifies the sun's rays.

Hours of exposure to bright sunlight and its reflected glare can also irritate your eyes, give you a headache, and even cause a form of temporary blindness similar to snow blindness. You can protect your eyes by wearing good-quality sunglasses that are designed to filter out the sun's harmful ultraviolet rays. Wraparound glasses offer the most protection.

Your first exposure to the sun at the beginning of the boating season should be brief, since your skin will not yet have built up resistance to the harmful effects of the sun's rays. If you do become sunburned, you should if possible stay off the water until your skin has returned to normal or at least take extra precautions against further exposure of the burned area. Sunburn can be as painful and have consequences as serious as any other burn. Even a moderate sunburn can make you very ill, and a severe case may cause scarring. Excessive exposure to the sun over a long period of time can also cause skin cancer, especially in fair-skinned persons.

Chapter Four

Using Your Boat

Boat Handling Techniques

Handling even the simplest boat in the least challenging water environment requires some special skills and knowledge. Much of what you need to know about boat handling you can learn from books and classroom instruction, but to become a competent boater you must reinforce what you learn with on-the-water, hands-on experience. Practice is essential for learning new skills; mastery is achieved only when learned responses become automatic.

An excellent way to begin learning about boat handling is with some kind of hand-powered watercraft. Canoes, kayaks, and rowboats can be compared to bicycles. They are inexpensive, simple to operate, and useful both for transportation and for recreation; and like bicycles, they provide a good introduction to traffic situations and the "rules of the road." By starting your boating life close to the water in a manually powered craft, you will quickly acquire a feeling for the water environment and the sometimes awesome power of wind, tide, and current. Boating without sails or a motor will limit your speed and probably your cruising range, but it will enable you to experience in the most direct way the forces that act on a boat and how the boat responds to them. Learning to handle a paddlecraft or a rowboat will prepare you well for sailing or powerboating.

Getting Your Boat into the Water

Whatever boat you begin with, you will face the problem of transporting it to the water and launching it. This will be simple if you have easy access to a suitable launching site and your boat is small and light enough to be carried on top of your car and launched by hand. Getting a larger boat on the water requires more planning and know-how, plus some additional equipment. You will have to transport the boat on a trailer and launch it with a hoist or from a ramp.

If you are cartopping your boat, keep in mind that cartop loads are governed by provisions of the California State Vehicle Code. The boat must be securely lashed down and carried in such a way that it does not obscure the driver's vision or the front or rear lights of the car. The total height, width, and length of the car-boat combination must not exceed prescribed limits, and a large boat may have to be equipped with lights, reflectors, or a red flag as a warning to others on the road. For specific requirements, check with any field office of the California Highway Patrol.

The launching site. The best launching site is at a dock or slip in still water that is deep enough to keep your boat well clear of the bottom. By tying up your boat to a dock, you will make it easier and safer to board and load, and it will not drift away if it is left unattended. Unless you do all your boating from a marina or other well-equipped moorage, you may not always have a dock available. If, for example, you must launch your boat onto a river or stream, you may have to make do with just a gently sloping bank that is sheltered within a cove or a bend in the channel. When you have found such a spot, you should secure the boat to keep it in place until you have loaded it and are ready to shove off. Keeping a mooring line attached to a fixed object on shore during this operation is a good idea, especially if the current is strong. The last person to board the boat can cast off the line, push the boat free of the bank, and then climb aboard.

Trailering your boat. Your pleasure boat may handle like a dream on the water, but it may suddenly run wild on the highway, with possibly disastrous consequences, if you do not trailer it properly. Your trailer must be the right type and size for your boat, and it must be equipped and operated in the manner prescribed by law. You must know how to load the trailer, hook it up, tow it, and maintain it in safe operating condition. Like other highway vehicles, boat trailers must be registered and licensed. (See Fig. 4-1.)

Fig. 4-1. Boat trailer

The checklist that follows contains the basic requirements for safe trailering. You should supplement the list by reading the pamphlet *Towing Tips for Trailer Sailors* (available free from the California Department of Boating and Waterways).

- Know and obey the laws that apply to trailers and trailering.
- Never try to tow your trailer and boat with a vehicle that is not powerful or rugged enough to handle the load or that has any defect that could make it unsafe. The towing capacity of your car or truck should be listed in the owner's manual; if it is not, check with the dealer.
- Make sure the tires on the towing vehicle and trailer are inflated to the correct pressure. If they are not, the trailer may sway dangerously.
- Be sure the trailer hitch you are using is well engineered and is securely attached to the frame of the towing vehilce, not merely clamped to the bumper. The hitch ball must be the right size for the socket on the trailer tongue. Be sure also that the required safety chains are in place and are secured to the vehicle frame, not to the bumper. Inspect the hitch connection periodically during a long tow, for example at rest stops.
- After you have connected the trailer's taillights, stoplights, and directional signals (and clearance lights, if required) to the towing vehicle's electrical system, check the operation of all the lights. Malfunctions that are not due to burned-out bulbs can usually be traced to loose or corroded contacts in the lamp sockets or in the plug connectors.
- If your trailer is equipped with brakes, make sure they are working properly. Remember that if the trailer brakes get wet during launching or haul-out, they will have little stopping power until they dry out.
- When launching in salt water, wash the trailer with fresh water after each use.
- Know the weight of your boat and all the gear you have stowed aboard it, and make sure that the total weight does not exceed the load rating for the trailer. (Check the data plate on the trailer.) Make sure that the load is well secured and properly distributed. The center of balance of the loaded trailer should be slightly forward of the wheels, so that about 5 to 10 percent of the total weight is carried on the trailer tongue. If you are trailering an outboard with the motor attached, make sure the motor is well secured and that its weight is supported under the transom.
- If you are trailering a boat that obstructs your view to the rear, the towing vehicle must be

equipped with a rearview mirror on the right side as well as the left side. Adjust each mirror so that it gives you a view of the highway for a distance of at least 200 feet (61 metres) to the rear of the vehicle.

- Give yourself some extra room when you are trailering a boat. Follow other vehicles at a safe distance; your boat and trailer could jackknife in a panic stop. Take care not to drift over the centerline, especially on curves. Change lanes smoothly to avoid whipping the trailer, and remember to use your directional signals. Steer wide around corners.
- Do not attempt to pass unless you are sure you have time and room enough to do so safely. If you are being passed by a bus or other large vehicle, be prepared for air turbulence that may make your trailer sway, but do not brake. As the pressure wave from the overtaking vehicle moves forward along the trailer, it will tend to correct the sway.

Using a boat ramp. A boat ramp is a paved incline extending down the bank and into the water. (See Fig. 4-2.) If you have trailered your boat to the site, you can launch it from a ramp as follows:

1. Before entering the ramp, remove all the tie-downs that secure the boat to the trailer, but leave the winch line attached. Make sure the drain plug is in place in the boat, and have a bow line attached and ready for use. If possible, have the boat ready to go, with all needed gear aboard, before you enter the ramp. Taking care of the preliminaries before you launch saves time, and getting under way quickly is a courtesy to others who may be waiting to use the ramp.
2. Back cautiously down the ramp until the stern of the boat enters the water and the boat begins to float free; then stop the car, turn off the engine, place the transmission in "park" (or in first gear, if it is a manual transmission), and set the parking brake. For added safety, chock the rear wheels of the car before proceeding with the launching.
3. Release the winch line, hold the bow line, and push the boat free of the trailer. Launching will be easier and safer if you have a boating partner to assist you.
4. Make the bow line fast to a mooring post, or have your partner hold it; then without delay get the car and trailer off the ramp and into a parking place.

To get the boat out of the water, back the car and trailer down the ramp until the trailer is in the water far enough for the boat to be pushed or driven onto it. (If your trailer does not have a winch, you may need some help to get the boat all the way on.) As when launching, be sure to set the car's parking brake, stop the engine, and put the transmission in "park" or first gear. Chocking the rear wheels is a sensible precaution.

Fig. 4-2. Launching at a ramp

Get the boat fully onto the trailer and secure it before you begin to haul out; moving a heavy boat forward when the trailer is out of the water may be almost impossible.

Boarding and Loading

If you are launching your boat from a ramp and there is no dock or slip nearby, board the boat by stepping into the bow from the ramp while someone on shore is holding the bow line. The person holding the line should continue to do so until you are ready to get under way.

Before boarding and loading your boat from a dock or slip, tie it up securely with at least a bow line but preferably also with a stern line. Hang fenders over the side to keep the hull from rubbing against the dock. If you are moored in a tidal area and must leave the boat tied up for more than a short time, be sure to allow enough slack in the line so that the boat will rise and fall with the tide. (See Fig. 4-3.)

When boarding a small boat from a dock, step over the gunwale and into the center of the boat, steadying yourself by holding onto the gunwale. If you step on instead of over the gunwale, or if you leap aboard and land too far from the center, the boat will tip and may even capsize. You may then find yourself in the water along with all your gear and anyone else who happened to be in the boat when you tried to board. (See Fig. 4-4.)

The best way to load a small boat from a dock is to hand the supplies and equipment to a passenger who is sitting or standing as close as possible to the center of the boat. If you are loading the boat by yourself, first place the gear to be loaded on the dock beside the boat. Then step aboard, and from a safe location near the center of the boat, reach over and lift the items aboard. Arrange the load so that its weight is evenly distributed and as low in the boat as possible; otherwise the boat may be unstable and difficult to handle. Be sure also that you do not put more weight in the boat than it is designed to carry safely. An overloaded boat is hard to handle and dangerous to be aboard. The excessive weight makes it sluggish in turns and other maneuvers, and because it rides low in the water, wave action that would not affect a properly loaded boat might swamp it. To determine the maximum allowable loads for your boat, check the manufacturer's capacity plate, which you should find displayed inside the boat near the operator's station. (See Fig. 4-5.)

Fig. 4-3. Mooring in tidal areas

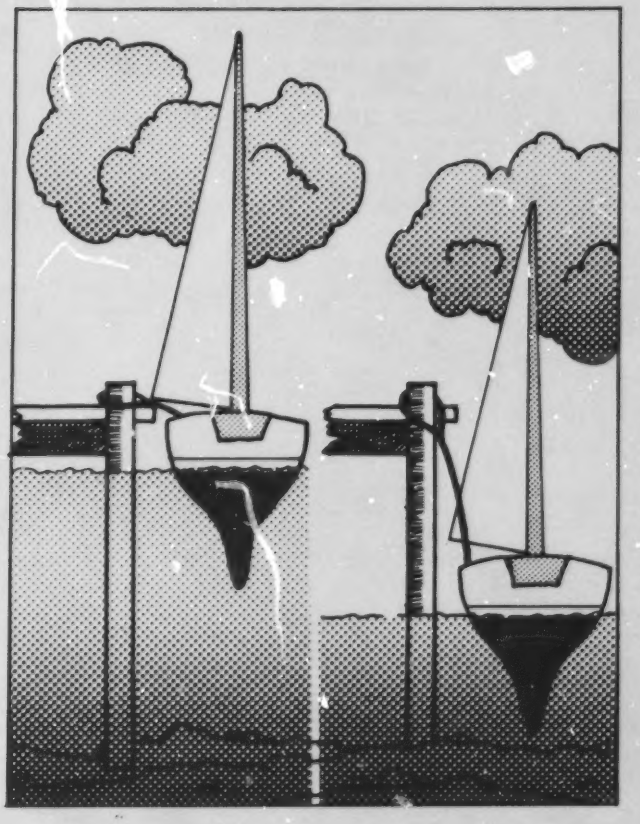
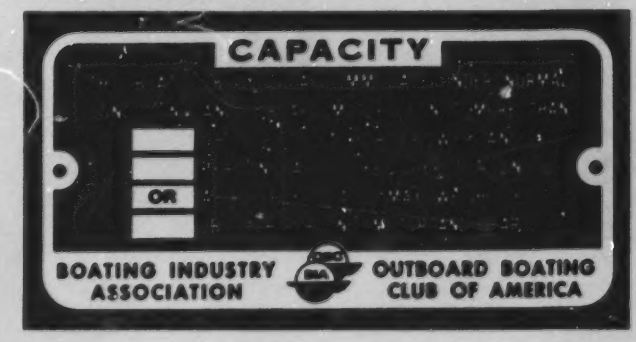


Fig. 4-4. Boarding from a dock

Fig. 4-5. Capacity plate



Getting Under Way and Coming In

A vessel is said to be "getting under way" when it starts to move away from a dock, shore, or anchorage and to be "coming in" when it is approaching a dock, shore, or other location where it will be tied up, anchored, or taken out of the water. Some special hazards are associated with getting under way and coming in, and to avoid them you must pay full attention to what you—and others on the water—are doing. In most instances you will be navigating in close quarters with several other watercraft, which means increased risk of collision. Also, much of the time you will be close to shore in relatively shallow water, with a greater chance of running aground or running afoul of a submerged object. When you are getting under way, proceed slowly and with extreme caution until you are beyond the area of heavy traffic and shallow water. Observe similar precautions when you are coming in. Remember that a vessel that is getting under way or coming in has no special privileges and must conform to all applicable rules of the road.

When you are operating a motorboat close to a marina or other place where many boats are kept, be careful not to exceed the posted maximum speed limit. At speeds greater than about five miles per hour, a motorboat can create a wake large enough to give boats tied up at a marina a good shaking. On the water as on the highways, speed limits are posted and enforced to protect property as well as lives.

Dock Landings

Many boating accidents that occur during dock landings are the result of coming in too fast. True speed can be deceiving on the water. You might think you are approaching the dock slowly enough for safety, but you could be in trouble if you misjudge the wind and current velocities in the docking area. The best procedure is to first bring your boat to a stop a safe distance from the dock so you can study the wind, water, and traffic conditions. If possible, approach the dock from the leeward side (heading into the wind); that way, the braking effect of the wind will help you lose speed and avoid making a hard landing. Coming in against the current (if any) is also helpful. If both wind and current are present and they are coming from different directions, plan your docking approach so that you can head into the stronger of the two, if possible. You may have to adopt a compromise heading to make best use of the combined forces of the wind and current.

With fenders in place over the dockside gunwale to prevent damage to the hull, approach the dock slowly at an angle, using just enough power to maintain control. When you are a few boat lengths from the dock, throttle down to mimimum power and allow the boat to glide in under its own momentum. If your motorboat (or your sailboat under auxiliary power) is still moving too fast, a short burst of reverse power will correct the problem. If you are docking a canoe or a rowboat, you can slow the craft or bring it to a stop by holding the paddle or oars still in the water at midstroke, or by back-paddling.

Dock landings for sailboats under auxiliary power are much the same as for motorboats. However, many skippers prefer to come in under sail whenever it is safe and practical to do so, using techniques described later in this chapter.

Canoeing

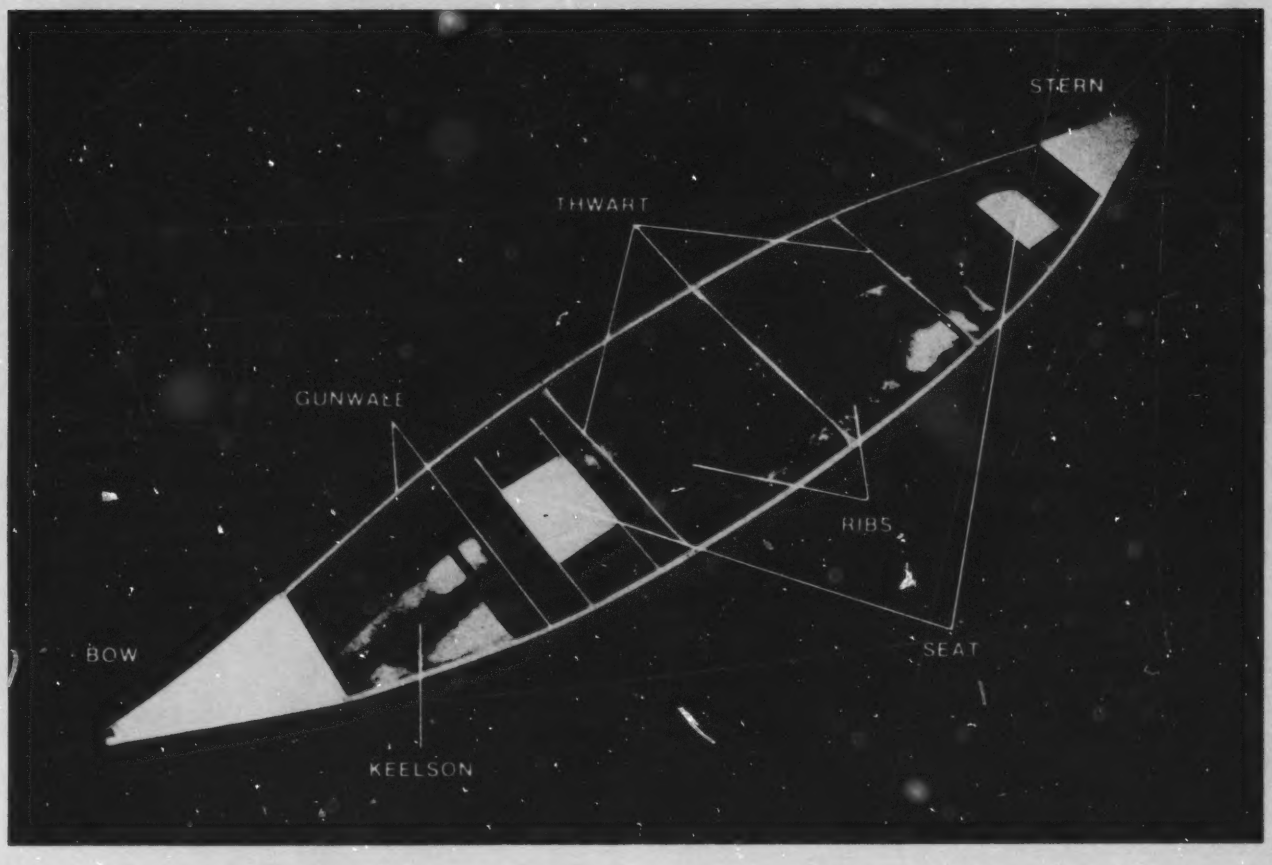
Modern canoes are made of aluminum, fiberglass, wood laminates, or plastic. (See Fig. 4-6.) They are lighter and stronger than the traditional birchbark canoes of the American Indians, but they are basically similar to those earlier craft in their general appearance and handling characteristics. In colonial and frontier times, when the inland waterways were as important for travel as the highways now are, the canoe was as basic a means of transportation as the horse. The narrow beam and shallow draft of the canoe enabled it to make progress through almost any kind of water, including swamps, and its light weight made it easy to carry overland when portage became necessary. These virtues of the canoe have ensured its popularity as a recreational watercraft, but they are offset somewhat by the hazards associated with canoeing. Again because of their narrow beam, shallow draft, and light weight, canoes are easy to tip over if they are improperly loaded, boarded, or handled. A skillful canoeist may be able to navigate the full length of a white-water stream without capsizing or even getting very wet, but a novice who loads or boards a canoe in the wrong way is likely to get a dunking before leaving the dock.

General Canoeing Skills

The primary rule for safe canoeing is to keep your weight and that of your passengers and gear low in the boat, with the weight evenly distributed. Make sure that the gear is lashed down. Unless you are poling your canoe, do not stand up in it. Move cautiously if you must shift your position when you are afloat; steady yourself by grasping the thwarts, and maintain a low crouching posture.

Boarding the canoe. If you are boarding a canoe that is alongside a dock, enter the boat just aft of amidships in a crouching posture, stepping in on the centerline and holding onto the gunwale. Boarding will be easier and safer if the canoe is tied up or if there is someone nearby to steady the craft and keep it from moving away from the dock. If you are canoeing alone, you will probably have to cast off the bow and stern lines yourself before getting in, so use extra caution when boarding. (The mooring lines will likely be beyond

Fig. 4-6. Parts of a canoe



your safe reach from within the canoe.) Canoe boarding techniques are shown in Fig. 4-7.

Paddling positions. The basic paddling positions commonly used in canoeing are shown in Fig. 4-8. In the normal cruising position, the canoeist kneels upright on both knees, with the thighs and trunk erect and the body facing slightly toward the paddling side. The buttocks may be resting against a thwart or against the forward part of the seat. When greater stability is required, the canoeist may vary the normal cruising position by kneeling lower and sitting back on his or her legs.

In the relief position—so called because it is often alternated with the normal cruising position—the canoeist sits back against a thwart or the forward part of the seat while kneeling on one knee (the one on the paddling side) and extending the other leg forward.

In the high kneeling or racing position, the paddler kneels upright on one knee (again the one on the paddling side), with the other leg extended forward with only a slight bend at the knee. The leg on the kneeling side is extended back diagonally across the canoe, usually with the foot and ankle braced under a thwart. The racing position is sometimes used by experienced canoeists to cover a lot of water quickly and with the least effort.

A canoe may also be paddled from the sitting position, but only if the water is calm and the weight of the passengers and gear can be distributed so that the craft is stable and properly trimmed. Stability and good trim may be difficult to achieve, however, since the paddler's weight will be relatively high in the canoe.

Exchanging positions with your canoeing partner. If you are paddling in tandem with another person, you and your partner may wish to exchange positions occasionally for variety or to develop skill in the different paddling techniques used at the bow and at the stern. The best place to make the change is at shore, but it can be done safely afloat—preferably close to shore—if the water is calm and the correct procedures are followed. Remember that during any change of position aboard a canoe, only one person should move at a time. Assuming that you are the bow paddler and you wish to take the place of your partner in the stern, you should proceed as follows:

Fig. 4-7. Boarding a canoe

1. Stow your paddle in the bow while the person in the stern keeps his or her paddle in the water to help stabilize the craft.
2. Grasp the gunwales and rise to a crouching position; then step backward over the bow seat and the thwart and sit down in the canoe as near the center as possible. Keep your hands in contact with the gunwales throughout the maneuver.
3. Remain seated while the stern paddler stows his or her paddle, grasps the gunwales and rises to a crouching position, then steps forward over you and moves up to the bow.
4. When your partner is safely seated in the bow and is steadying the craft with the bow paddle, rise again to a crouching position and continue as before to the stern.

Canoeing in Moving Water

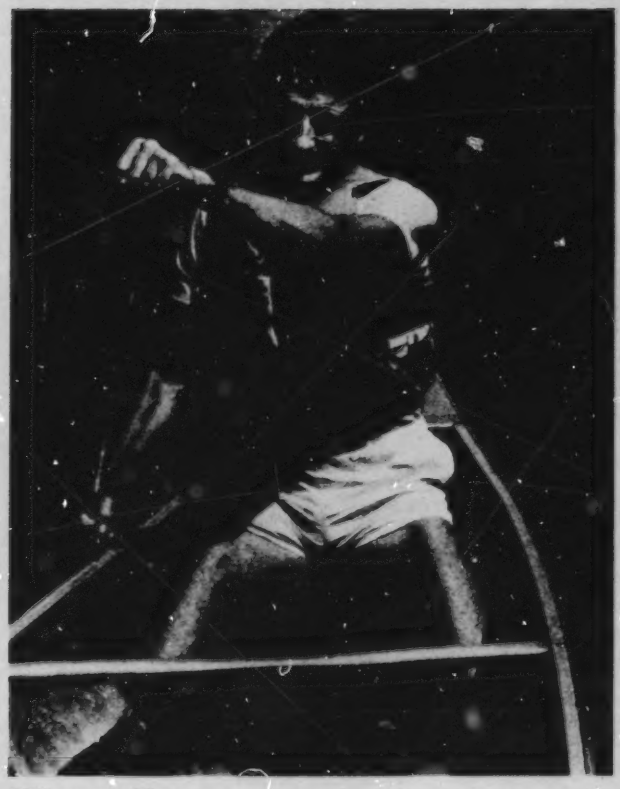
Canoes are versatile watercraft that are adaptable to many kinds of water environments, from the calmest flat water (lakes and slow-moving rivers and streams) to the most turbulent white water (rapids in a river or stream where the water sprays and foams as it rushes through narrow channels and around rock formations). Flat-water canoeing is fun, and it is a good way to learn and practice basic boating skills. White-water canoeing is a much more dangerous form of recreation. You should not attempt it until you have mastered flat-water canoeing and have had some training in white-water techniques. Much useful information about flat-water and white-water canoeing is available in the many excellent publications that deal with these

Fig. 4-8. Paddling positions

Normal cruising position

Relief position

High kneeling or racing position



Sitting position

subjects; some recommended titles are listed in the Selected References section of this book. You will also need "hands-on" instruction. Most white-water canoeists learn the skills of their sport from other more experienced boaters, starting on relatively gentle streams and progressing to more difficult ones. (See Fig. 4-9.)

Reading the water. Most accidents with paddle craft in moving water result from boaters overestimating their ability or underestimating the hazards of the water. White-water enthusiasts rate rivers according to their degree of difficulty and the skill required to run them, as shown in Table 4-1. In general, open canoes are suitable for use only on flat water and Class I and II rivers. Before you attempt to run a river or stream with which you are not thoroughly familiar, you should scout it to identify potential danger spots. Remember that the characteristics of a river can change dramatically, sometimes in just a few hours, as a result of heavy rains, snowmelts, or releases of water from a dam upstream. Never canoe alone in moving water; travel in a group of at least three boats, and keep the boat behind you in sight.

A skilled canoeist, kayaker, or rafter can tell a lot about the boating conditions on a river or stream by observing the waves and other disturbances that appear on its surface. For example, a pillow of water that rises above the level of the surrounding water is a danger signal; it is formed by the current rushing over a rock or other obstacle that is just below the surface. On the other hand, a series of scallop-shaped waves ("haystacks") downstream from a narrow channel is normally a sign of slowing current and deeper water. (See Fig. 4-10.)

Hydraulics and strainers. Hydraulics and strainers are among the most serious hazards that may confront boaters in moving water. A hydraulic is the strong reverse current that is often present on or near the surface of the water at the foot of a low dam or waterfall. The reverse current is produced by the contour of the streambed just below the fall. With the passage of time, the water cascading over the dam or waterfall wears a hollow in the streambed, and the current begins to curl back on itself. (See Fig. 4-11.) A canoeist or kayaker who is caught in a hydraulic may be unable to get free without help, and even if the boater is able to escape, the boat may remain trapped there until it breaks up.

A strainer is a similar kind of hazard. (See Fig. 4-12.) It is a partially or fully submerged fallen tree or other debris in a river or stream that allows water to flow through but obstructs boating traffic. A strainer can trap and hold a swimmer or a small watercraft. Tremendous pressure may be exerted on an object caught in a strainer; a moderate current can pin a 15-foot (4.57-metre) canoe against a strainer with a force of a ton or more.

Table 4-1. Classes of rivers by degree of difficulty

Class I: Very easy (practiced beginners)
Waves small and regular; passages clear; sandbanks and some artificial difficulties, such as bridge piers; riffles.

Class II: Easy (intermediate skill level)
Rapids of medium difficulty, with clear, wide passages; low ledges. Spraydeck useful.

Class III: Medium difficulty (experienced canoeists)
Waves numerous, high, and irregular; rocks, eddies; rapids with clear but narrow passages, requiring expertise in maneuvering; inspection of the watercourse usually needed. Spraydeck needed.

Class IV: Difficult (highly skilled canoeists with several years' experience with organized groups)
Long rapids, waves powerful and irregular; dangerous rocks; boiling eddies; passages difficult to reconnoiter; inspection mandatory before first run; powerful and precise maneuvering required. Spraydeck essential.

Class V: Very difficult (teams of experts)
Extremely difficult, long, and very violent rapids that follow each other almost without interruption; riverbed extremely obstructed; big drops, violent current, and very steep gradient; reconnoitering essential but difficult.

Class VI: Extremely difficult (teams of experts)
Difficulties of Class V carried to the extreme of navigability; nearly impossible and very dangerous. Should be attempted only by teams of experts taking all precautions, and only at favorable water levels and after close study of the watercourse.

Rowing

Outboard motors have virtually replaced oars as the primary means of propulsion for small, general-purpose watercraft. Rowboats still have some applications as utility boats, for example as tenders for larger vessels, but their main use today is recreational. Hunters and anglers use rowboats when their sport takes them to places where the use of motorboats is prohibited or impractical. Some rowing craft, such as racing shells and white-water dories, are designed for sporting activities, but most are limited to less challenging kinds of recreation on protected waters. However, even a common rowboat can be a source of much healthful fun and exercise. And although rowing now has only limited uses, it is still recognized as a basic nautical skill.

Fig. 4-9. Fast-moving water

Fig. 4-10. Haystacks

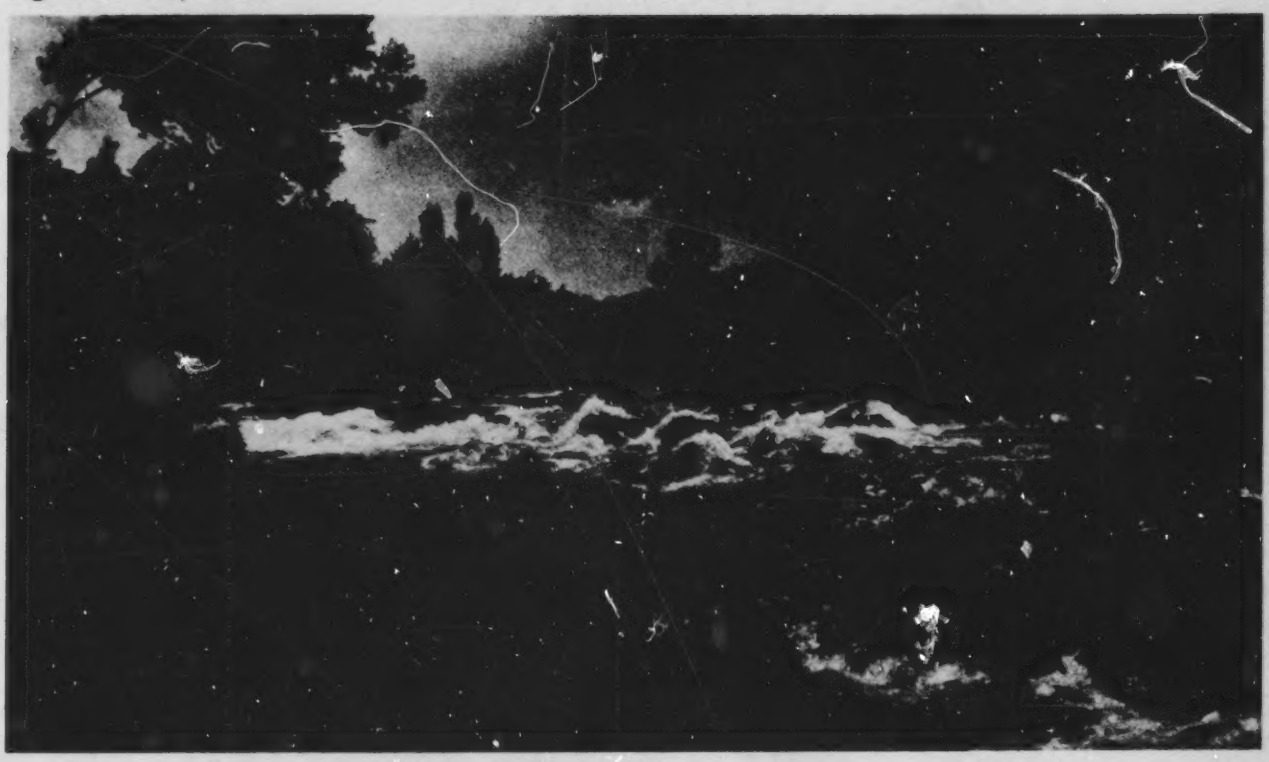


Fig. 4-11. Hydraulic

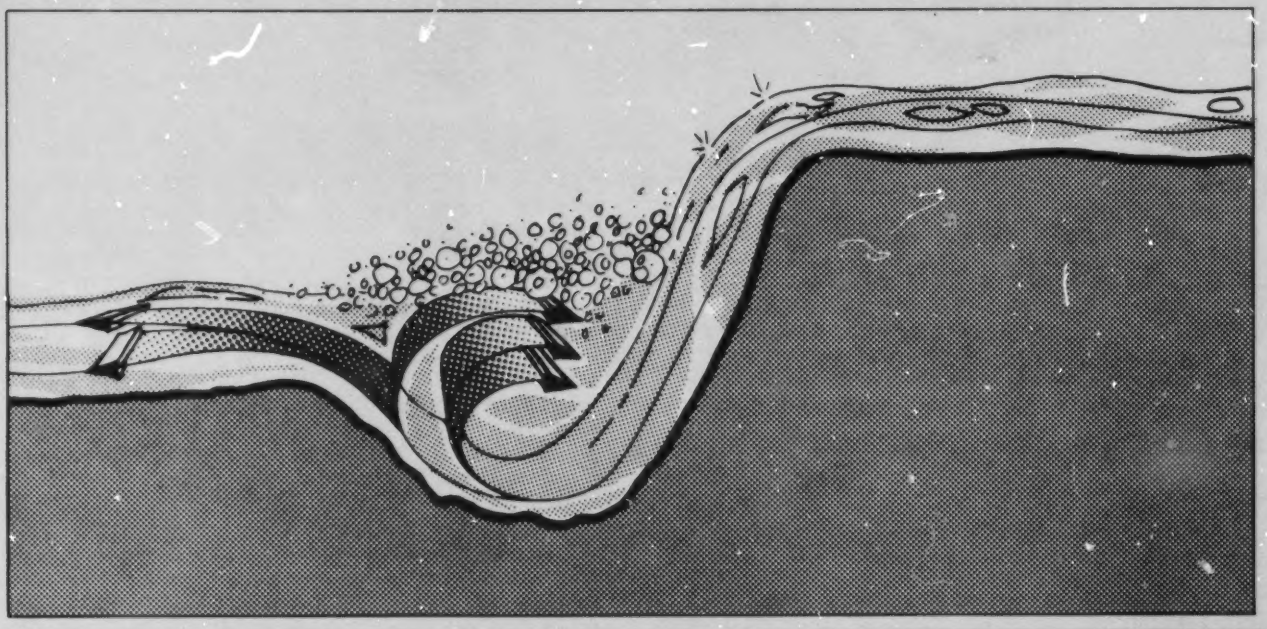


Fig. 4-12. Strainer

Characteristics of Rowboats

Modern rowboats may be of conventional wood-plank or plywood construction, or they may be manufactured of aluminum, laminated wood, resin-impregnated fiberglass, or plastic. Rowboats are available in many sizes and shapes for a variety of uses. The heavier the load or the more passengers, the greater the size of the boat. To obtain a rough estimate of the passenger-carrying capacity of a rowboat or other small craft with a conventional hull, multiply the length of the boat by the maximum width of the boat (both measurements in feet and tenths of a foot), and then divide the result by 15. Thus, a 10-foot (3.05-metre) boat with a 3.5-foot (1.07-metre) beam would safely carry 2 persons (rounded down from 2.3) under normal conditions. The passenger-carrying capacity will be reduced if gear and equipment are also being carried. Apply the above rule conservatively, taking into account the design and general seaworthiness of the craft and the water environment in which it will be used.

Flat-bottom rowboats should be used only in protected waters; they are not as seaworthy as V-bottom or round-bottom boats, and they are more affected by crosswinds. For best stability, a rowboat should have a broad base. The rougher the water, the higher should be the gunwales; the larger the swells or waves, the greater the need for a pointed bow and a pointed stern. A large, heavy rowboat may require tandem oar placements for extra rowing power. (See Fig. 4-13.)

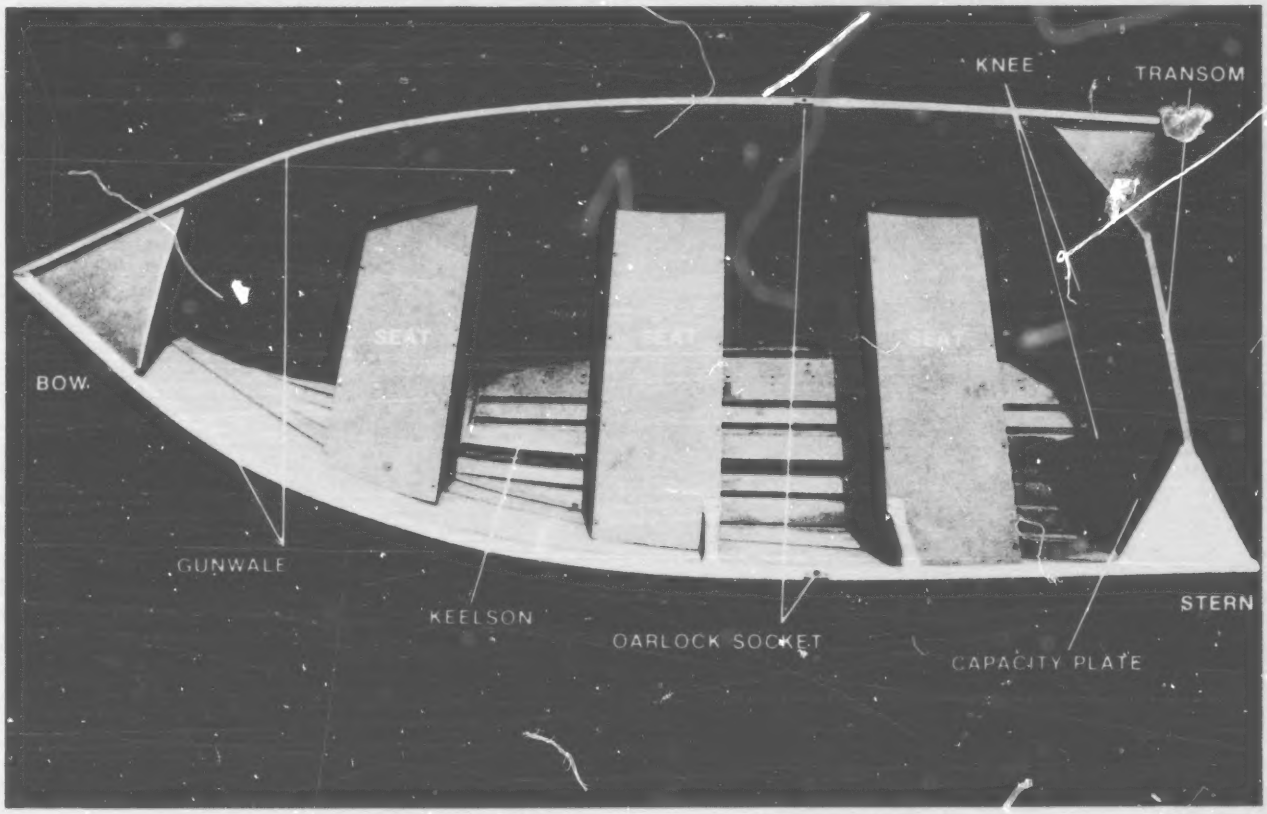
Boarding and Debarking

Like all small watercraft, rowboats tend to be skittish when you are boarding them. Before boarding a rowboat from a dock, be sure the craft is tied up at both the bow and the stern. Enter the boat at or near amidships by stepping over, not on, the gunwales, and keep your weight low and near the centerline of the boat. Never jump from the dock into the boat. Hold onto the gunwales when you move about in the boat. If passengers are coming aboard, have them do so one at a time. Reverse the procedure and observe similar precautions when you are debarking from a docked rowboat or other small craft.

Rowing Technique

The usual solo rowing position is with the rower seated at or near amidships, facing the stern. During the complete cycle of a correctly executed rowing stroke, the oars move smoothly through the following

Fig. 4-13. Parts of a rowboat



positions: catch, pull, finish, feather, and recovery. (See Fig. 4-14.) To practice the rowing stroke, proceed as follows:

1. Start by holding the oars horizontal and straight out from the boat, with the blades turned vertical (the "dress oars" position). Then rotate your wrists downward so that the oar blades are turned almost horizontal (feathered), and in one smooth motion swing forward from your hips and push the handles ahead of you until the blades are in position for the catch (with the oars angled back about 45 degrees toward the bow).
2. Straighten your wrists to turn the oar blades vertical again; then make the catch by easing up on the oar handles, allowing the blades to sink to their floating depth.
3. Continue smoothly into the pull part of the stroke by swinging your body back through the vertical, at the same time pushing with your legs to develop extra power. Keep your back and arms straight and your eyes level. Finish the pull by drawing the oar handles in toward your chest, keeping your elbows low.
4. At the end of the pull, when the oars are angled about 45 degrees toward the stern, press down slightly on the oar handles to bring the blades up out of the water. As the oars come up, bend your wrists down again to feather the blades for reduced wind resistance during the final or recovery part of the stroke. (Note: If your oars are the type that are permanently pinned to the oarlock, you will not be able to feather them.)
5. To execute the recovery and prepare for the next stroke, swing your body forward from the hips as you thrust the oar handles toward the stern, as in step 1. Keep the oars nearly horizontal and the oar blades feathered during the recovery.

Powerboating

A motorboat as defined in federal law is any vessel 65 feet (19.8 metres) or less in length that is propelled by machinery, except tugs and towboats. Motorboats and other small watercraft are grouped by length, primarily for equipment requirements, as follows:

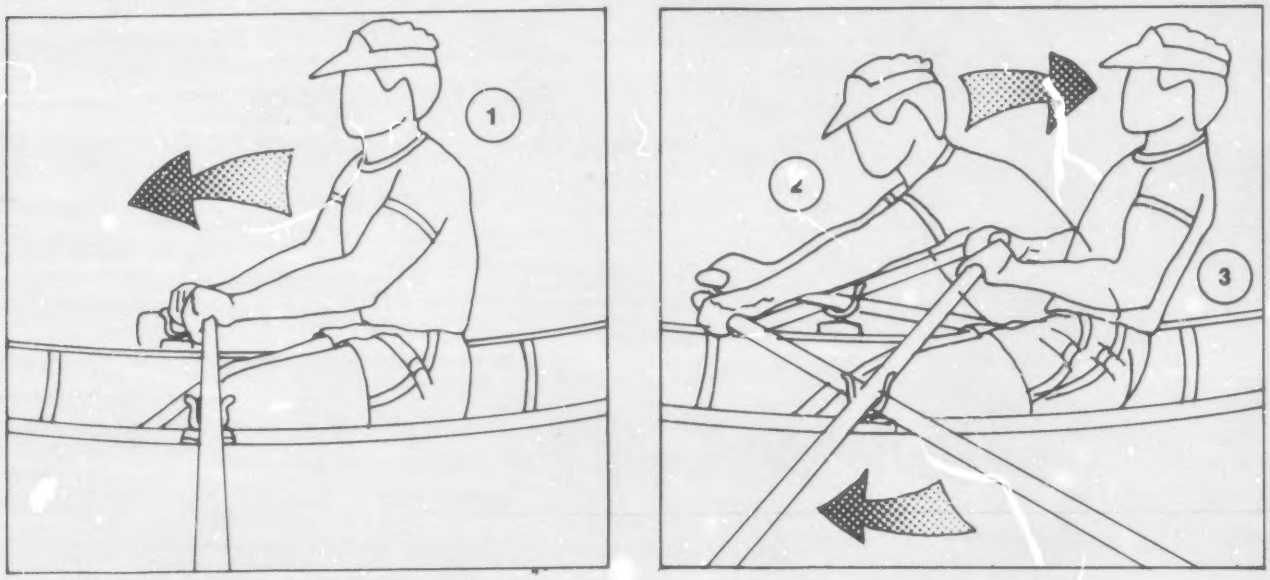
- Boats less than 16 feet (4.9 metres) in length
- Boats 16 feet (4.9 metres) to less than 26 feet (7.9 metres) in length
- Boats 26 feet (7.9 metres) to less than 40 feet (12.2 metres) in length
- Boats 40 feet (12.2 metres) to not more than 65 feet (19.8 metres) in length

Motorboats are available in an almost bewildering assortment of types and sizes—from simple 7-foot (2.13-metre) water scooters to fully equipped and luxuriously appointed 65-foot (19.8-metre) cruisers. However, most motorboats purchased for recreational use are runabouts and small cruisers under 26 feet (7.9 metres) in length, and most are powered by outboard motors.

Matching the Motor to the Boat

Whether you use your motorboat for fishing, cruising, towing water-skiers, or racing, the craft will be

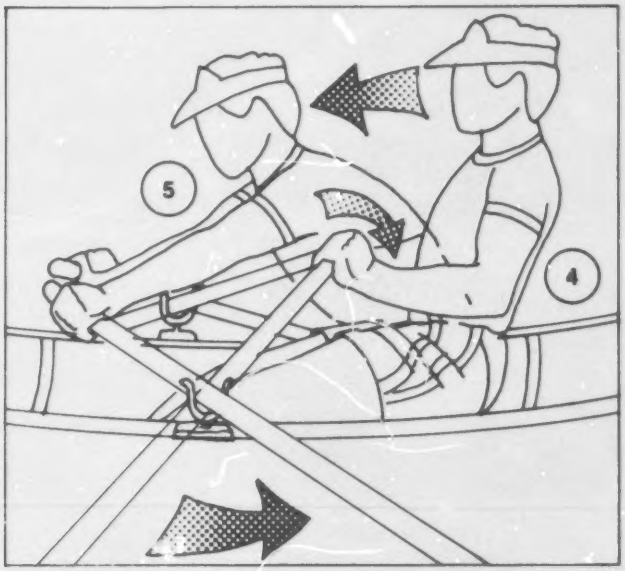
Fig. 4-14. The rowing cycle



safer and easier to handle if it is equipped with the right motor. If the motor is too large, its extra power (and extra weight, if it is an outboard) will make the bow rise and the stern dip, and the bad trim will make the boat unstable and vulnerable to swamping. On the other hand, a boat with an undersize motor will be sluggish and hard to steer, which could make it unsafe in emergency maneuvers. If your craft is an inboard or inboard-outboard (stern drive) motorboat that has not undergone modifications since it left the factory, you are probably safe in assuming that the factory-installed motor is the right size for the boat. If your motorboat is an outboard, make sure the motor you intend to use does not exceed the maximum horsepower rating shown on the capacity plate for the boat.

Displacement hulls and planing hulls. Boat hulls are of two basic types: displacement and planing. Boats with displacement-type hulls include rowboats, canoes, and other manually powered craft; most sailboats and large, ocean-going powerboats; and motorboats of the less sporting variety (most utility boats and many small fishing boats, for example). Most recreational motorboats have planing-type hulls.

The displacement hull is so named because it always displaces an amount of water equal to the weight of the boat, regardless of the speed of the boat through the water. A boat with a planing hull also displaces water in proportion to its weight, but only when it is at rest or moving slowly. As the boat gains speed, the hull begins to rise higher in the water and finally comes up "onto the plane," skimming the waves with minimum displacement and very little water resistance. Planing hulls are lighter and faster than displacement hulls, and they usually have flatter bottoms.



Fuel and Fueling

Running out of fuel is at best embarrassing and inconvenient, and the consequences can be much worse if you are stranded in a dangerous situation, say near a rocky leeward shore with a storm coming up. To avoid this problem, make it a habit not to leave the dock with less than a full tank of fuel, and reserve two-thirds of your fuel supply for the return trip. If your boat is an outboard with a motor that requires oil to be mixed with the gasoline (most do), check the owner's manual to determine the correct mixture for the engine (usually about 50 parts gasoline to one part oil). Use only the oils and fuels recommended by the engine manufacturer.

Fueling precautions. Fires and explosions—mostly as a result of improper fueling procedures or faulty fuel systems—are a major cause of boating accidents that result in personal injury or death. To be safe, observe these precautions when fueling:

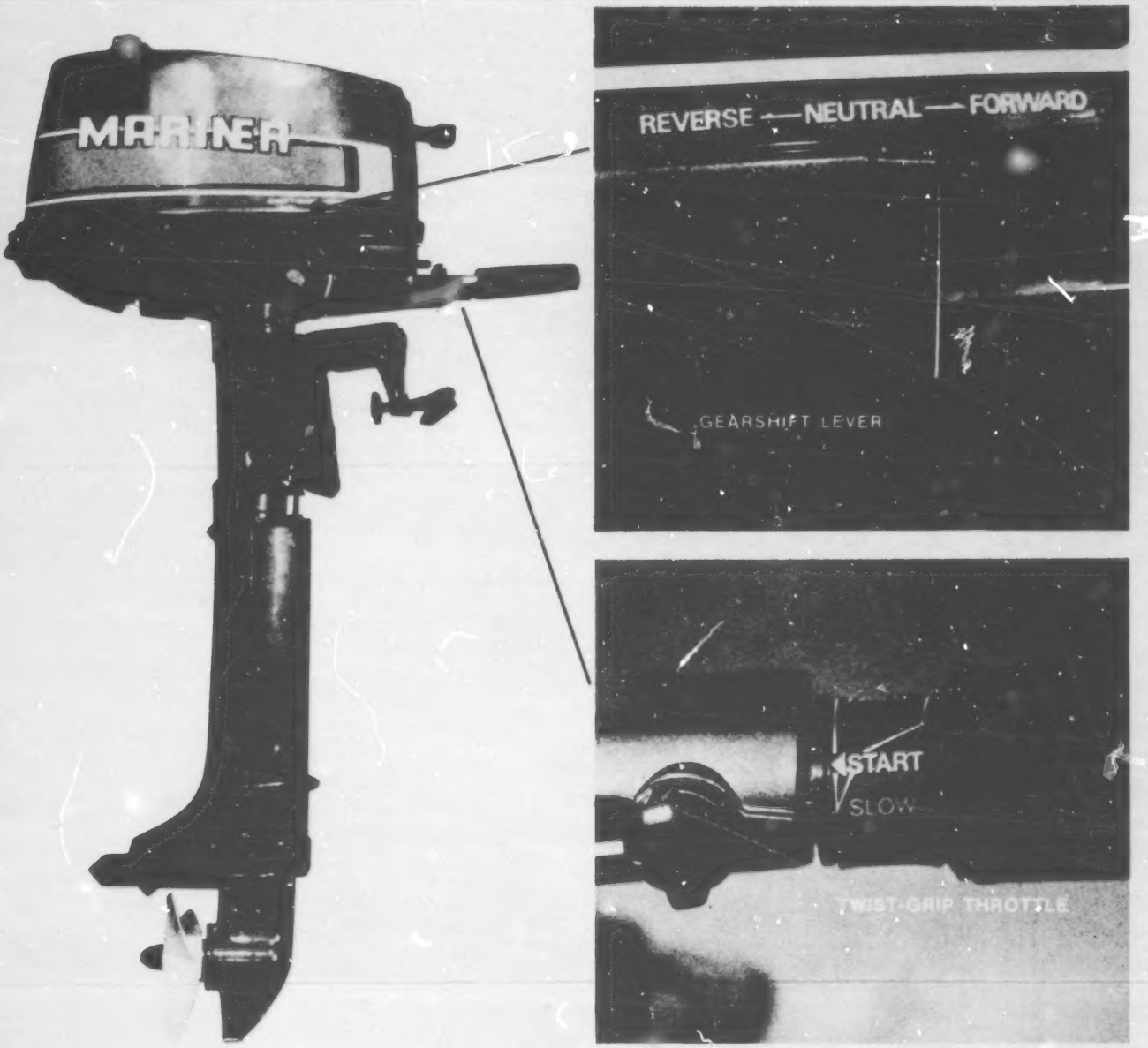
1. Always fuel in good light.
2. Be sure that the boat is moored securely, with the engine shut off.
3. If your boat is an outboard with a portable fuel tank, fill the tank on the dock, not on the boat.
4. Before filling an on-board fuel tank, extinguish all sources of heat and flame aboard the boat, and switch off all electrical equipment. Allow no smoking. Keep a fire extinguisher handy.
5. Close all doors, hatches, and other openings in the boat that could allow gasoline fumes to enter a compartment or the bilge.
6. When filling the tank, keep the fuel-hose nozzle in contact with the filler pipe to prevent the buildup and sudden discharge of static electricity between the nozzle and the pipe. Be sure the filler pipe is electrically connected to the boat's ground system.
7. Be careful not to overfill the tank, both to prevent spillage and to allow room for the gasoline to expand with rising temperature. Do not immediately withdraw the hose nozzle from the filler pipe when you have completed the fuel delivery; wait a moment to allow any fuel remaining in the line to drain into the tank.
8. Cap the fill opening, and wipe up any spilled fuel.
9. Open all compartments and allow the boat to ventilate for at least five minutes. Turn on the bilge blowers if the boat is so equipped.
10. Check all compartments for gasoline odors before restoring power to electrical equipment, relighting pilot flames, or starting the engine.

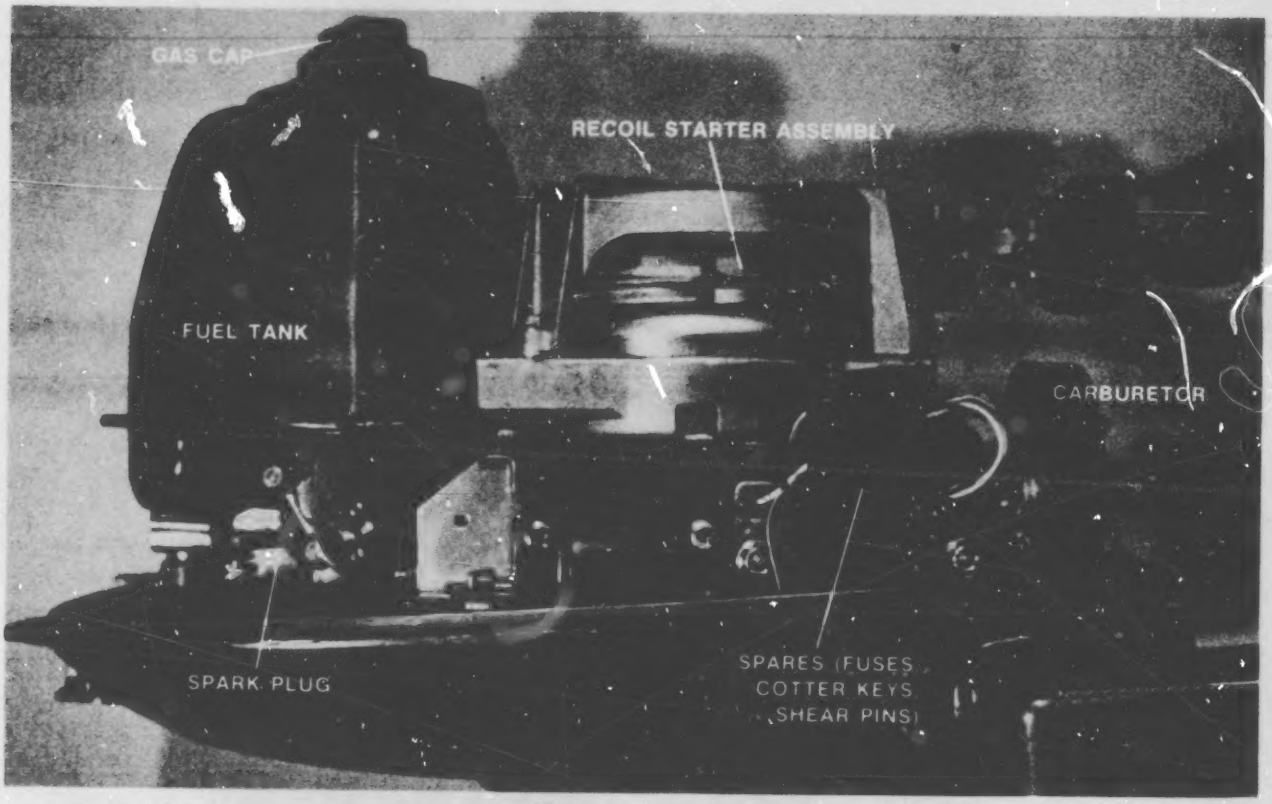
Starting an Outboard Motor

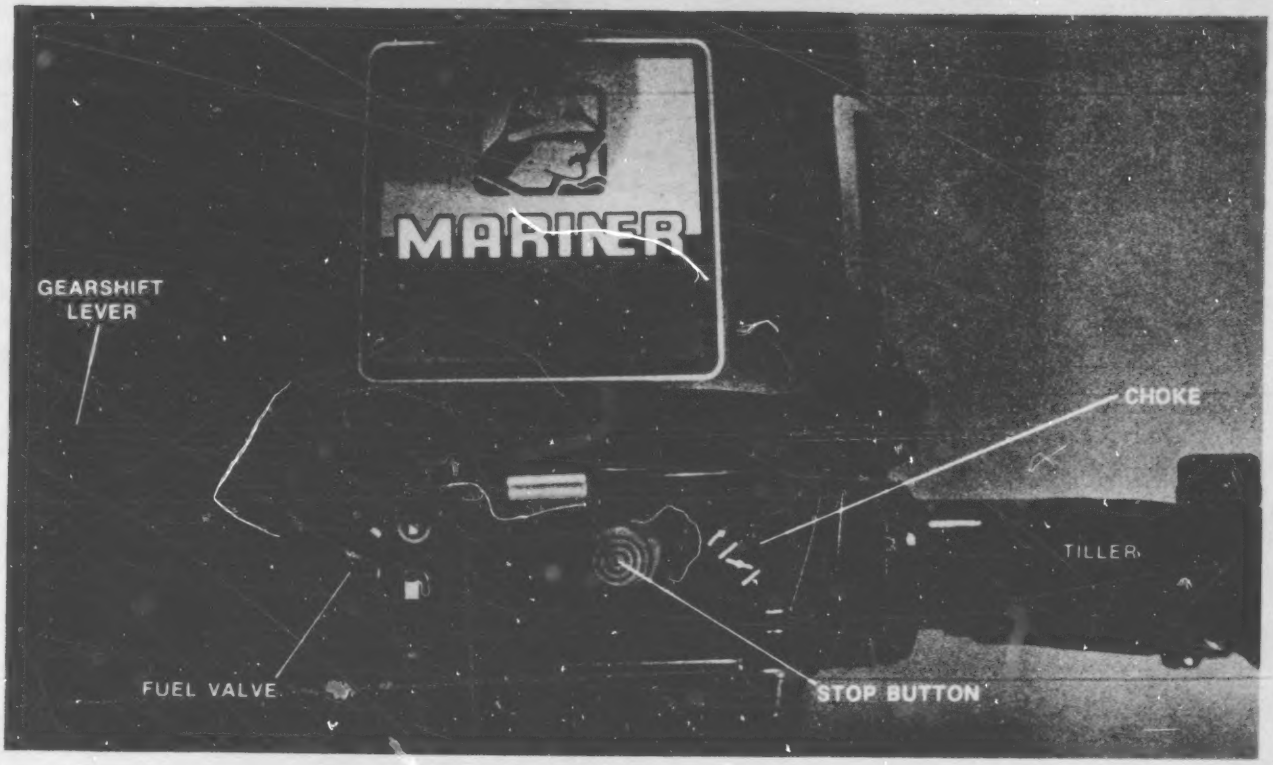
An outboard motor equipped with a gearshift and a recoil-type starter is shown in Fig. 4-15. The general procedure for starting such a motor is as follows:

1. Moor the boat securely.
2. If fuel is supplied to the motor from a portable tank, attach the fuel line and prime the system. (Squeeze the priming bulb a few times.)
3. Put the gearshift lever in neutral and lock it out of reverse.
4. Move the speed control to "start."
5. If the motor is cold, pull out the choke.
6. From a sitting position, pull lightly on the starter cord until the starter mechanism engages; then complete the pull in a rapid, smooth motion. (A fast spin is necessary to vaporize the fuel and produce a hot spark.) Hold on to the starter-cord grip during rewind; do not simply let it fly back, as this may break the cord or damage the starter mechanism.
7. Push in the choke after the motor starts. If the motor does not start after a few forceful spins, do

Fig. 4-15. Typical outboard motor




GAS CAP
RECOIL STARTER ASSEMBLY
FUEL TANK
CARBURETOR
SPARK PLUG
SPARES (FUSES
COTTER KEYS
SHEAR PINS)


MARINER
GEARSHIFT
LEVER
CHOKE
TILLER
FUEL VALVE
STOP BUTTON

not continue with the choke fully out, as you may flood the motor and foul the spark plugs. Stop and perform the routine ignition- and fuel-system checks described later in this chapter.

8. After the motor has started, check for water flow through the cooling system.

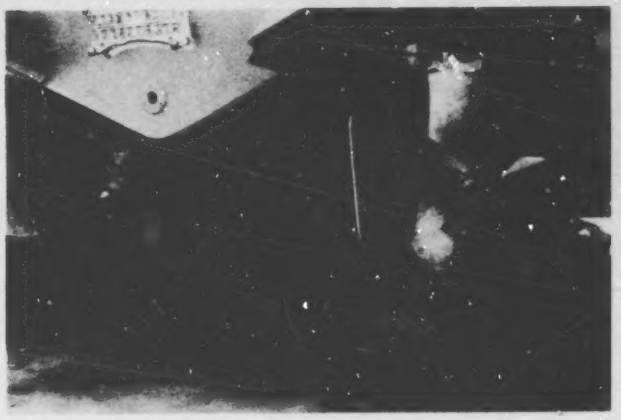
If your outboard motor is a direct-drive type (with no gearshift lever), you should not start the motor until you have cast off the mooring lines, pushed clear of the dock, and pointed the boat toward open water.

Steering Fundamentals

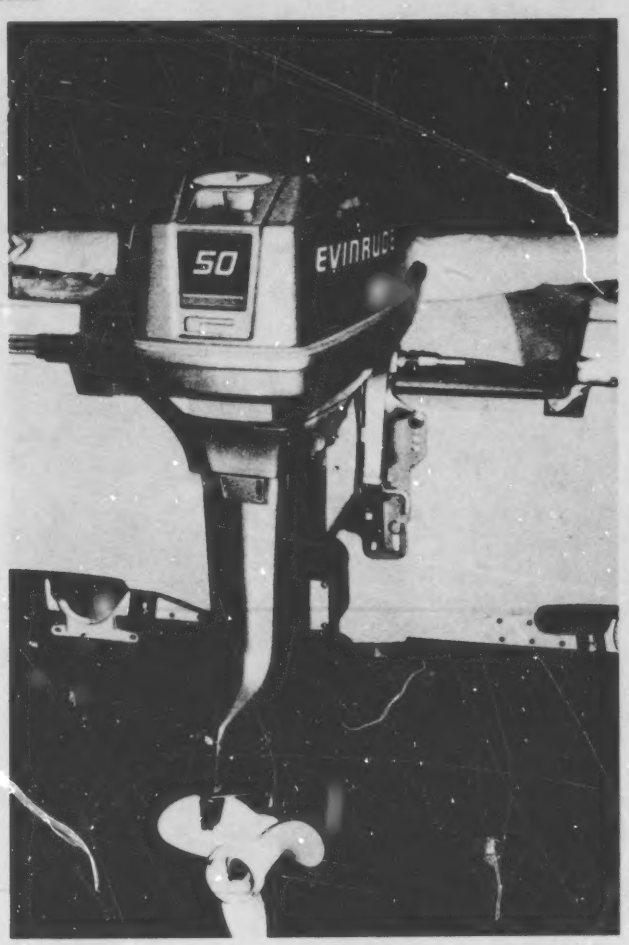
All conventional motorboats are propelled by the thrust of a mechanically produced stream of water. In some inboard motorboats, the engine drives a turbine pump that draws in water from under the hull and expels it with great force from an aft-facing nozzle. The powerful discharge not only propels the boat, but also steers it when the operator swivels the nozzle to the right or left. Most motorboats, however, are propeller driven. The angled blades of the rotating propeller develop the thrust that moves the boat, and if the boat is an outboard or inboard-outboard, steering is accomplished by changing the direction of the thrust, as in a jet-drive boat. Outboards are steered by turning the entire motor and drive unit on its vertical axis; inboard-outboard boats are steered by swiveling the outdrive mechanism.

Since the propeller of an inboard motorboat cannot be swiveled to change the thrust direction, the boat is steered by means of a rudder, which is usually located just aft of the propeller. When the boat is getting under way and moving at low speed, the rudder steers mainly by deflecting the stream of water coming from the propeller. As the speed of the boat increases, the current flowing past the stern combines with the propeller current and begins to influence steering. (See Fig. 4-16.)

Fig. 4-16. Motorboat propulsion and steering systems



Inboard



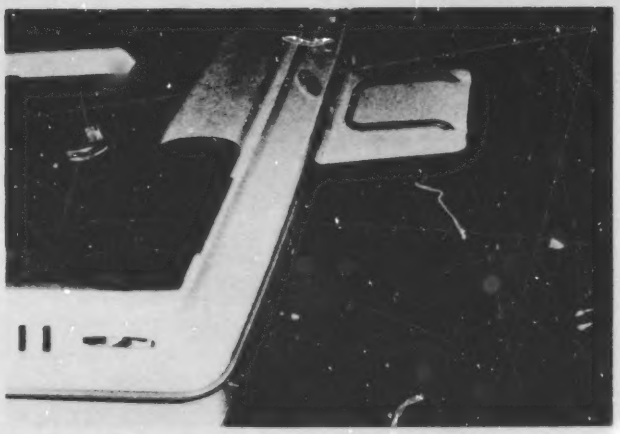
Outboard

Even if your powerboat is equipped with a steering wheel, you will find that steering a boat is a different experience from steering an automobile. For one thing, the boat travels on an unstable and very slippery "road," and the inertia of the boat keeps it from responding instantly when you turn the steering wheel. And when the boat does start to turn, the stern changes direction first; then the bow changes. (See Fig. 4-17.) This is true whether the boat is well under way or is just beginning to move from the dock. You must therefore watch where the stern is going as well as the bow, especially when you are maneuvering near a dock or in close quarters with other watercraft. Remember also that making tight turns at too high a speed is as dangerous in a motorboat as it is in a car.

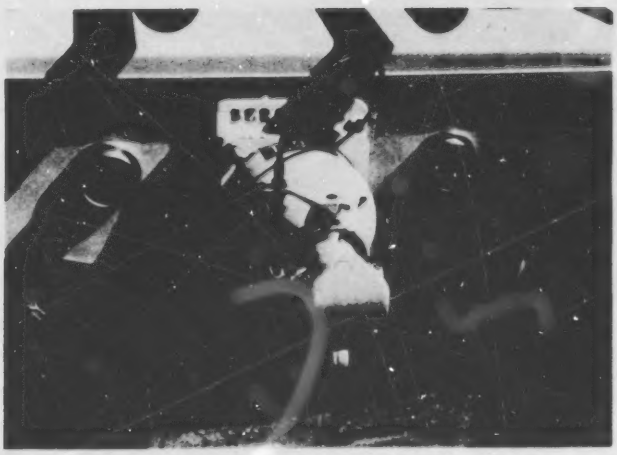
Troubleshooting a Disabled Marine Engine

Modern marine engines give little trouble if they are properly maintained, kept reasonably dry, and kept supplied with fuel, lubricating oil, and coolant. The best source of information about the operation and maintenance of your inboard or outboard boat motor is the owner's manual. If a breakdown occurs when you are out on the water, having the motor manual aboard can be as important as having the necessary tools and spare parts.

Diagnosing the trouble. Most troubles in a boat motor can be traced to the fuel system, the ignition system, or the drive train. If your motor stops unexpectedly or will not start, check the most obvious trouble spots first, beginning with the fuel supply. Make sure there is fuel in the tank and that the fuel is getting to the motor. If the motor dies after it has been drenched by a wave or by spray from a passing boat, check for wet ignition parts. If the motor runs but the boat does not move, the trouble is in the drive train (most likely a broken shear pin if the boat is an outboard or an inboard-outboard).

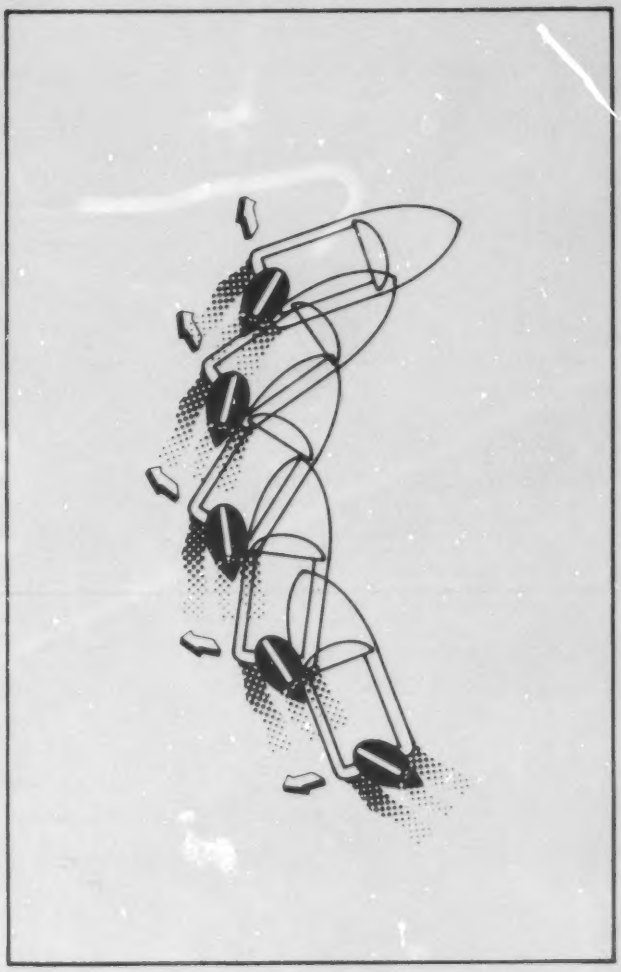


Inboard-outboard



Jet drive

Fig. 4-17. How a motorboat steers



Deciding whether a boat motor has failed because of ignition trouble or fuel-system trouble is not always easy. Both kinds of trouble produce similar symptoms, and both may be contributing to the problem. An over-rich fuel mixture due to a defective or misadjusted carburetor will make the motor run rough and tend to stall, but so will a fouled spark plug. To complicate the matter further, the fouled plug may be caused by an over-rich fuel mixture, by flooding due to overpriming or overchoking, or (if the motor is an outboard) by too much oil in the fuel.

In general, if a motor that has an adequate supply of fuel quits suddenly, or if it does not respond at all when you energize the starter or pull the starter cord, the trouble is probably in the ignition system. If the motor sputters to a stop, of if it fires occasionally when you are trying to start it, the trouble is more likely to be fuel related. Unless the source of the trouble is obvious, the quickest and best way to pinpoint it is to perform step-by-step checks of the ignition system and the fuel system.

Before checking the ignition system or any of the other electrical components in a powerboat, guard against fire and explosion by making sure that no spilled gasoline or gasoline fumes are present anywhere on the boat. Give special attention to the bilges and the engine compartment. Remember that gasoline fumes are heavier than air and tend to settle in low places. If necessary, ventilate the boat thoroughly before proceeding. Whenever possible, get to shore before attempting repairs.

Checking the battery. If the electric starter of your inboard or large outboard motor responds weakly or not at all when you turn the ignition switch to "start," the source of the trouble is most likely a weak or dead battery. However, since trouble of this kind is also commonly caused by corroded battery cables and loose or corroded cable terminals, you should inspect these items before testing the battery.

A DC voltmeter or even an improvised test lamp can be used to determine the state of charge of the battery, but a better way is to use a hydrometer (specific gravity tester). If the battery is fully charged and in good condition, the hydrometer reading at each cell will be about 1.275. The cells of a battery that is only 50 percent charged will read about 1.200; readings below about 1.150 mean a dead battery.

The hydrometer readings also give information about the general condition of the battery. If all the cells are low by approximately the same amount, the battery can probably be recharged successfully; but if the hydrometer readings from cell to cell vary by more than about 30 points (.030), the battery has some weak cells and probably will not take a charge.

If you use a voltmeter to check the charge level of your battery, first make sure the cable terminals are clean and tight on the battery posts; then measure the voltage at the terminals. A fully charged battery will have an output of 12 to 13 volts when it is not under load. Even when the battery is supplying the heavy current needed to operate the starter motor, its voltage should not drop much below 10 volts.

Never attempt to test a storage battery by shorting across its terminals with a screwdriver or a pair of pliers. The result could be melted metal or an explosion accompanied by a spray of electrolyte (sulfuric acid solution). For the same reason, never use a match or other open flame to inspect the electrolyte level in the cells of a storage battery. Explosive hydrogen gas may be present in the cells.

Checking the ignition system. Most small outboard motors have recoil-type starters and magneto ignition systems and, therefore, do not require a battery. However, if your boat is powered by an inboard gasoline engine or by an outboard motor large enough to have an electric starter, it will most likely have a battery-operated ignition system. The first step in troubleshooting such a system is to check the condition of the battery, as outlined above. When you have confirmed that the battery is in good condition and is supplying power to the electrical system, proceed with the ignition check as follows:

1. Disengage the drive (put the gearshift in neutral).
2. Visually inspect the high-tension cables and all other accessible parts of the ignition system. Look for moisture, broken or loose electrical connections, cracked or frayed insulation, and shorted or grounded wires. Make whatever corrections are necessary, and try again to start the motor. If you have no success, proceed to step 3.
3. Remove the distributor cap and inspect it for cracks, dirty or corroded terminals, or moisture. Check the ignition points for burned, dirty, or improperly gapped contacts. Burned points may be caused by a defective condenser; if you replace the ignition points, replace the condenser also.

   A small, inexpensive volt-ohmmeter (VOM) is a useful addition to a marine tool kit; it simplifies electrical troubleshooting. If you do not have a VOM, test ignition parts that you suspect are bad by substitution with new or serviceable used parts.

   If the ignition system is delivering high voltage to the spark plugs but the motor still will not start, turn off the ignition, remove the ignition key and put it in your pocket, and proceed to step 4.
4. Using a plug wrench, remove and inspect the spark plugs. Most spark plugs are fitted with copper gaskets that seal the plugs to the cylinder head; take care not to lose the gaskets. If any of

the spark plugs have cracked insulators or badly worn electrodes, replace them. Clean or replace plugs that have oily or heavily fouled electrodes. Make sure the electrodes are correctly gapped. When you remove the spark plugs, you will probably find that they are wet with gasoline as a result of your repeated attempts to start the motor; clean and dry the plugs before you reinstall them.

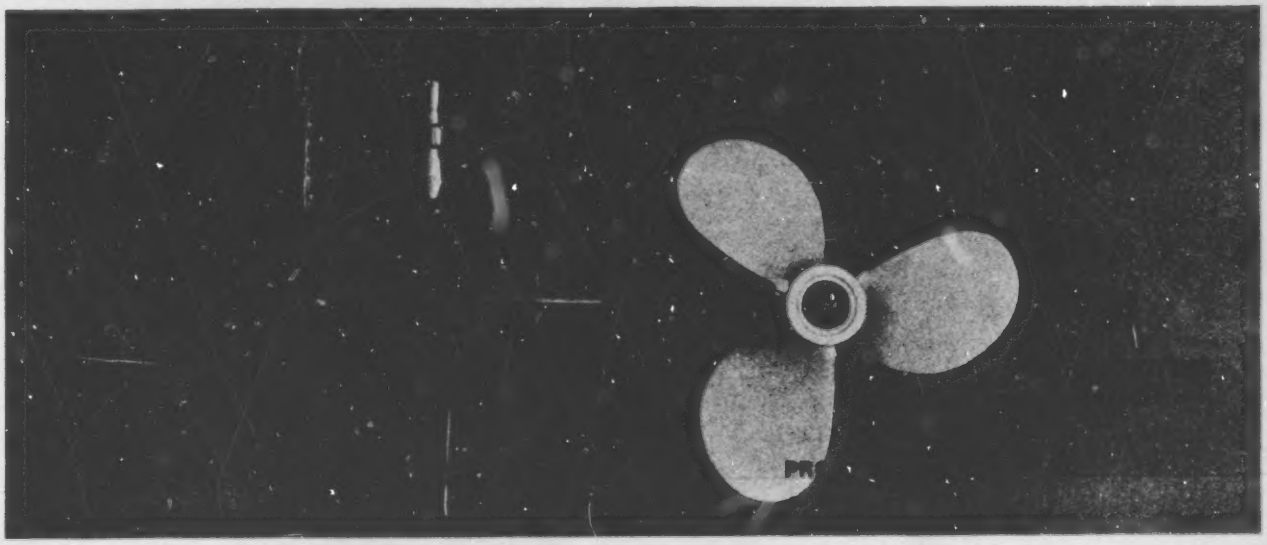
Checking the fuel system. If you suspect that the trouble is in the fuel system, first make sure you have fuel in the tank, then check the system as follows:

1. Check the fuel-tank vent to ensure that it is open and clear.
2. If there is a shutoff valve in the fuel line, make sure it is open. If the motor is an outboard with a portable fuel tank, squeeze the primer bulb a few times to fill the line.
3. See if fuel is present in the sediment bowl or fuel filter. If not, the fuel line may be blocked, or it may have a leak that allows air to enter at some point between the fuel tank and the fuel-pump inlet. Check the line for cracks, and tighten any loose fittings.
4. Check for dirt or water in the sediment bowl or fuel filter. Remove, clean, and reinstall the bowl or filter.
5. If the fuel line has no leaks or loose fittings but fuel is still not arriving at the fuel pump, disconnect the line and check it for blockage, preferably with a length of stiff wire. If you must blow through the line to clear it, take care not to get gasoline in your mouth. (Note: Before you can blow through the fuel hose from an outboard motor to a portable fuel tank, you must disconnect the hose from the primer bulb, which contains a check valve.)
6. If clearing and reconnecting the fuel line does not correct the problem, check the fuel pump. First disable the ignition system by unplugging and grounding the center high-tension cable in the distributor cap. Then disconnect the fuel line from the fuel pump to the carburetor, and operate the starter. If after a short period of cranking no fuel comes out of the line, the pump is probably defective. If any fuel is spilled during this test, wipe it up immediately, and dispose of the wiping rag in a safe place.
7. If the pump is delivering fuel, reconnect the fuel line and the high-tension cable and try again to start the motor. Use the choke sparingly if the motor is warm. If you do not have success after a short period of cranking, remove one of the spark plugs and check it for the presence of fuel. If the plug is dry, the trouble is probably in the carburetor. Inspect the choke to make sure it does not stick open when you try to close it. If the plugs are wet, you may have overchoked or overprimed the motor. Dry the plugs and reinstall them. Then, with both the throttle and the choke fully open, try again to start the motor.

Replacing a Broken Shear Pin

In many outboard motors and some inboard-outboards, a replaceable shear pin connects the propeller to the propeller shaft. (See Fig. 4-18.) If the propeller fouls a rock or other hard object when the boat is under way,

Fig. 4-18. Outboard-motor propeller assembly



the soft metal of the shear pin normally breaks and allows the propeller to turn free on the shaft, thus saving the propeller and the motor from serious damage. (Large motors may have a slip clutch in the drive train to provide this protection.) To replace a broken shear pin, proceed as follows:

1. Shut off the motor, and remove the ignition key and put it where it will not fall in the water. Put the gearshift in neutral.
2. Tilt up and lock the motor or outdrive unit so that the propeller is out of the water and within reach. Inspect the propeller for dents or other damage. (Having an extra propeller in your kit of spare parts is a good idea.)
3. Have your tool kit and the necessary spare parts at hand where you can reach them easily.
4. Using pliers, straighten and remove the cotter key that keeps the propeller in place on the propeller shaft.
5. Carefully slide the propeller out on the shaft until the broken shear pin is exposed. Then remove the pieces of the broken pin. (You may have to slide the propeller completely off the shaft to reach the shear pin.)
6. Turn the propeller on the shaft until the shear-pin hole in the shaft lines up with the slots in the propeller hub. Then carefully insert the new shear pin and slide the propeller in place over the pin.
7. Install and bend over a new cotter key. (Bend the halves of the key away from each other, not both in the same direction.)
8. Lower the motor or outdrive and lock it in place.

Waterskiing

Waterskiing is a team sport with three participants: the skier, the powerboat driver, and an observer. Each member of the team must know the fundamentals of the sport and the necessary hand signals, and each has a role to play in preventing waterskiing accidents. As in all other boating activities, however, ultimate responsibility for the success and safety of the operation rests with the skipper.

The Powerboat Driver

If you are skippering a waterskiing boat, choose a location and towing pattern that will allow you to keep the boat and skier at a safe distance from docks, piers, floats, other boats, and shallows. The tow rope should be at least 75 feet (22.9 metres) long. Keep the skier at least twice that distance from all potential hazards. Scout the area to make sure it is free of debris and underwater obstacles. At all times, be watchful for swimmers and divers.

Before you begin to pull up the skier, make sure the path ahead is clear and that the tow rope is not caught in the propeller or wrapped around the skier. Do not accelerate until the skier is ready for the takeoff, holding the towline handle and sitting back with the ski tips out of the water. (See Fig. 4-19.) When the skier shouts "Hit it," ease the throttle open until the slack is out of the line; then apply more power and bring the skier quickly and smoothly up to planing speed. Be ready to cut the throttle and abort the takeoff if the skier seems to be in trouble.

Precautions during the tow. When you are under way with a skier in tow, maintain a safe speed that is not

Fig. 4-19. "Hit it!"

excessive for the skill level of the skier. A good speed for beginners is 18 to 25 miles per hour (29 to 40.2 kilometres per hour). Remember also that the operator of a boat that is towing a water-skier has no special privileges and must observe all posted speed limits. The maximum speed for a boat within 100 feet (30.5 metres) of a bather is five miles per hour. This speed limit also applies within 200 feet (61 metres) of the following when in use: a bathing beach, swimming float, diving platform, marked swimming area, or passenger landing.

Avoid making sharp turns when you have a skier in tow, especially if the skier is cutting sharply outside your wake. If a dangerous situation forces you to make an unexpected turn, throttle back as you turn, and signal the turn to the skier. In an emergency you may have to drop off the skier, but it is better to do so than to risk an accident.

As skipper of the waterskiing boat, you are in command of the craft and have final authority in matters affecting its safe operation. However, you should remember that although the skier cannot operate the boat, he or she should at all times be able to control it by means of signals relayed to you through the observer. Be as helpful as you can, but except in emergency situations do not try to think for the skier.

Returning to a fallen skier. If the skier you have in tow falls, circle back to the skier immediately, keeping him or her always in view. (See Fig. 4-20.) Signal the downed skier that you are coming to his or her aid by holding up your hand. Never back the boat up to a person in the water; even if the boat is coasting with the engine idling and in neutral, the propeller may still turn and inflict injury. Determine the direction of the wind and current, and approach the skier so that the boat will tend to be pushed away from instead of over the skier. When you are close enough to coast up to the skier, put the gearshift in neutral and shut off the engine. If the downed skier wishes to come aboard, have him or her enter wherever it is safe to do so on your boat. Having a boarding ladder available on the boat is a good idea for persons who ski often.

If you are bringing aboard a downed skier who may have been injured in the fall, use extreme caution. Any injury may be aggravated by pulling the person aboard. Get into the water and support the skier until the nature and extent of the injury can be determined.

The Skier

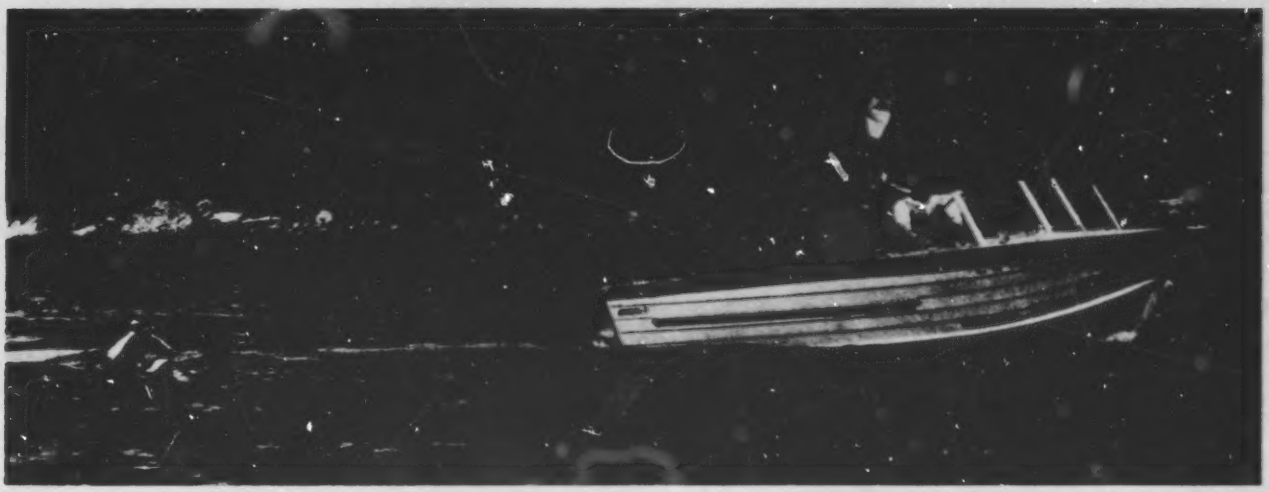
When you are skiing, be alert for cross wakes, floating or partially submerged objects, swimmers, rafters, and anything else that might come between you and the ski boat. Wear a Coast Guard approved ski vest at all times. In addition to its lifesaving function, your ski vest will protect your rib cage and cushion you in a fall, and its bright color will make you more visible to others in the area. It will also allow you to rest in the water while you are waiting for the ski boat. Ski belts were commonly used in the past, but they do not offer adequate protection to a fallen or unconscious skier and are therefore not approved by the Coast Guard.

If you are going to fall, relax and sit back. You can stop quickly by sitting back in the water and dragging your hands. Try to enter the water smoothly. If possible, avoid falling forward over your skis; you are more likely to be injured in a forward fall. If you fall, hold one of your skis partially out of the water in an upright position to warn approaching boats. Never ski when you are tired; tired skiers invite accidents.

The Observer

The observer keeps a close watch on the skier so that the driver can give full attention to the water

Fig. 4-20. Returning to a fallen skier



ahead. The person serving as observer relays signals between the skier and the driver and informs the driver when the skier is down.

Signaling

The waterskiing signals shown in Fig. 4-21 are approved by the American Water Ski Association and are recommended for use on California waters. Some other signals used by water-skiers to indicate their intentions are as follows:

- *Start:* Shout "Hit it" or nod the head.
- *Slower:* Make a thumbs-down gesture.
- *Faster:* Make a thumbs-up gesture.
- *Return:* Pat the crown of the head with an open palm.

Requirements of the Law

California law requires at least two persons to be aboard a boat that is towing a water-skier—the driver and an observer. The observer must be at least twelve years of age. Skiing from sunset to sunrise is prohibited. (Local laws may establish special hours.) Water skis must not be operated in a manner to endanger the safety of persons or property. Passing the towline over another vessel or skier or navigating between a vessel and its tow is also prohibited.

Although water-skiers in California are not required by law to wear Coast Guard approved life jackets, a skier in tow is considered to be a "person on board" for personal-flotation-device (PFD) requirements. This means that if the skier is not wearing an approved PFD, one must be provided for him or her in the boat.

Sailing

The principal parts of a typical small sailboat are illustrated in Fig. 4-22. All sail-powered craft respond to the forces of wind and water in basically the same way. The sails extract energy from the wind, then transfer that energy to the boat through the mast and the rigging. When the boat is sailing downwind (sailing before the wind or on a run), the wind simply fills the sails and pushes against them. However, the sails can also be adjusted (trimmed) to allow the boat to sail with the wind at its side or even facing partway into the wind, and the sails then react to the wind in a somewhat different way.

No sailboat can sail directly into the wind; the best most can do is sail about 45 degrees off the eye of the wind (the direction from which the wind is coming). When a sailboat is moving along this line, sailing as close to the wind as possible, it is said to be close-hauled, or beating the wind. If the sailor eases or lets out sail and turns the boat off the wind, so that the

Fig. 4-21. Waterskiing signals

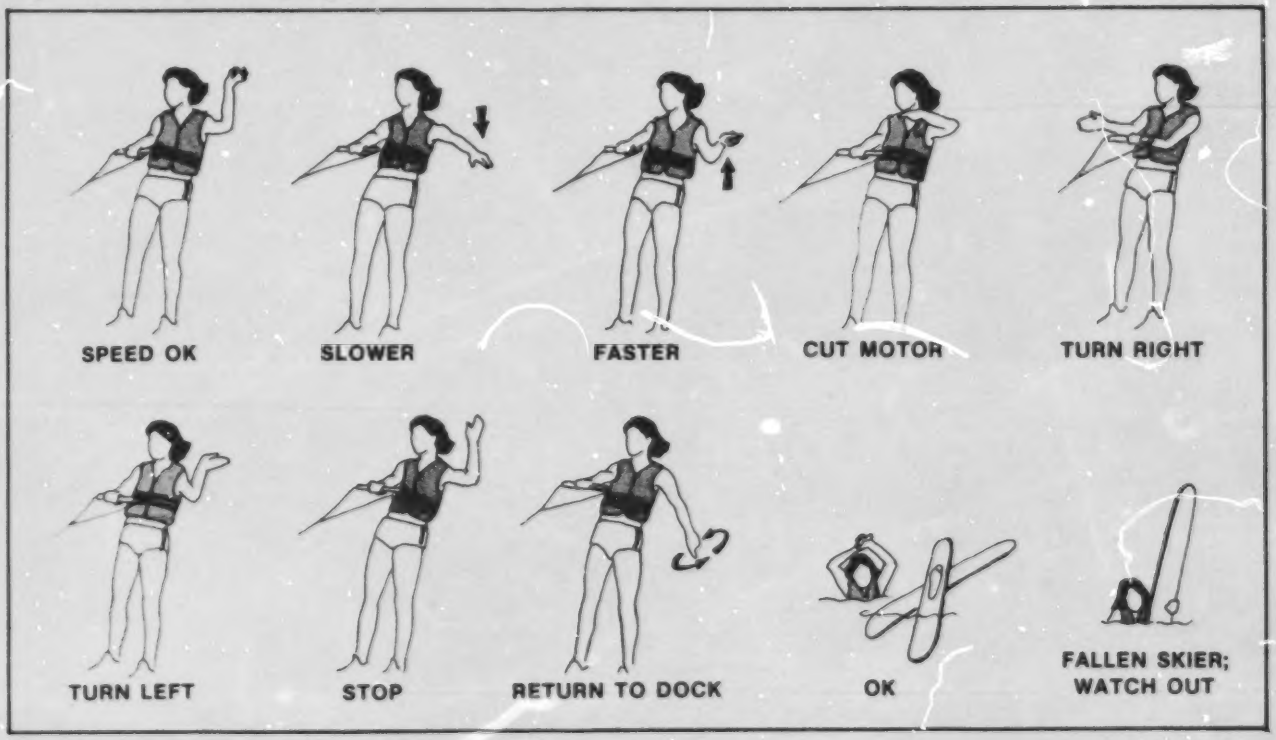
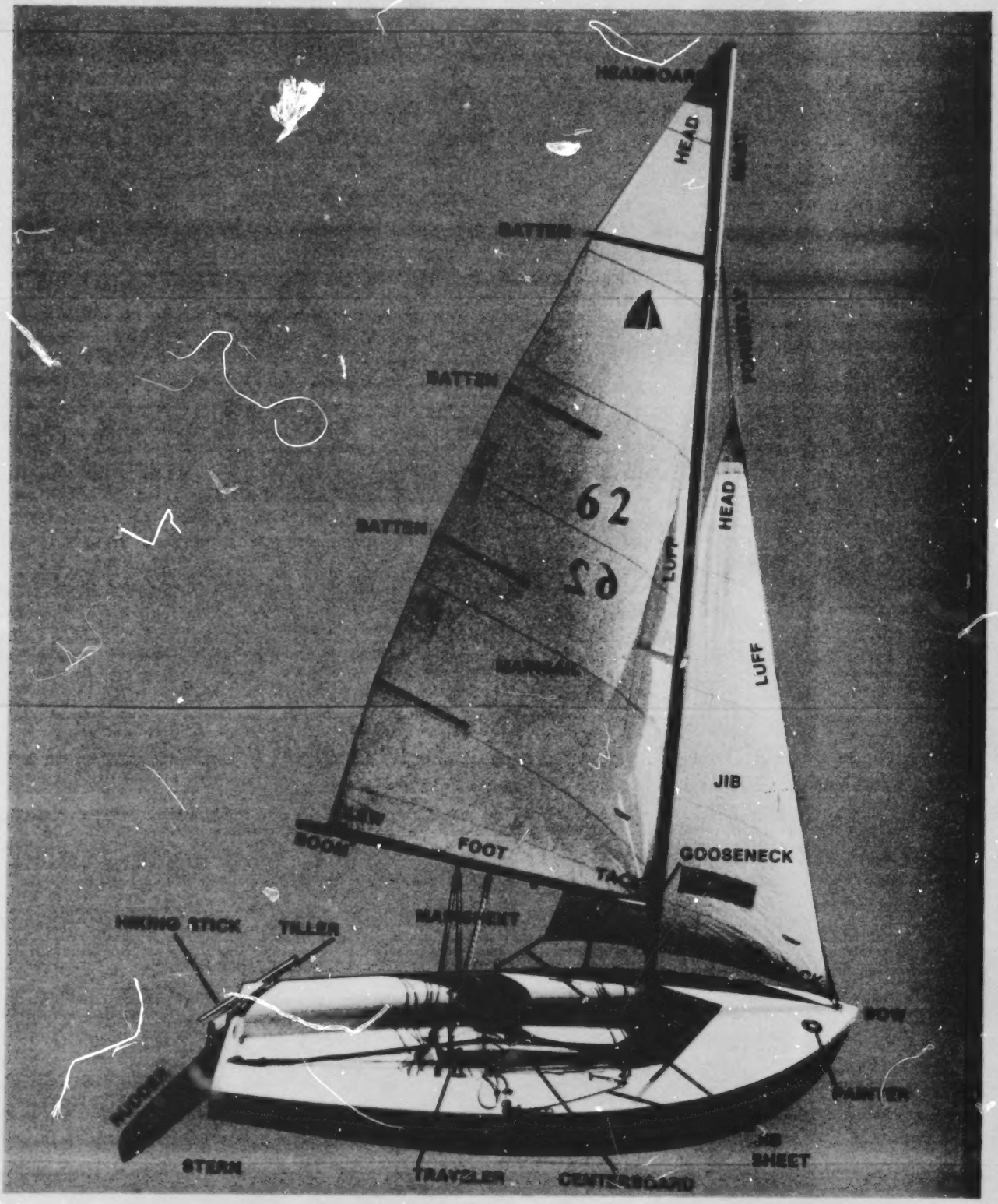


Fig. 4-22. Parts of a typical small sailboat



wind is more or less at right angles to the beam, the boat is said to be on a reach. When a sailboat is close-hauled or on a reach, the wind fills the sails and pushes against them, as on a run, but it also flows around the sails and produces a low-pressure area on their leeward side. The sails then function in part like an airfoil, providing forward thrust in much the same way that an aircraft wing provides lift. (See Fig. 4-23.)

The sails of a boat that is close-hauled or on a reach intercept the wind at an angle, and the wind therefore tends to push the boat sideways as well as forward. The tendency of a sailboat to drift sideways (make leeway) as a result of the forces of wind, waves, and current is counteracted by the keel, a fin-like downward extension of the hull. Small sailboats often have a swing keel or a retractable centerboard (daggerboard) in place of a fixed keel, as shown in Fig. 4-24.

Steering a Sailboat

Steering a sailboat is a different experience from steering a motorboat. In a motorboat, any change in direction—from a minor correction of a few degrees to a full-circle turn—can be accomplished by simply turning the wheel until the boat reaches the desired heading. However, changing the heading of a sailboat involves more than just putting the rudder over and waiting for the craft to complete the turn. Since the attitude of the sailboat relative to the wind is constantly changing throughout the turn, the sailor must keep a close watch on the sails and correct their trim when necessary to keep the boat under way and in stable condition. Also, the crew must be prepared to move quickly to new positions on the boat to restore balance if the craft begins to lean over (heel) excessively during some part of the turn.

On most small sailboats, the rudder is controlled by a tiller instead of a wheel. Steering with a tiller may seem a bit confusing at first, but with a little practice it becomes second nature. Pushing the tiller to the right moves the rudder to the left. This causes the stern to move to the right, pointing the bow to the left. The principle is therefore very simple: To turn right, push the tiller to the left; to turn left, push the tiller to the right; to go straight, return the tiller to the neutral (center) position.

Reading the Wind

Every sailor must learn to make quick and accurate judgments about the direction and velocity of the wind. An experienced sailor can often determine the direction of the wind just by the feel of the breeze on his or her cheeks or by the appearance of wind-driven ripples on the surface of the water. A beginner who is unsure about the wind's direction can determine it by temporarily loosening the mainsail and using it as a weather vane. A masthead fly (a wind vane on the mast) is also helpful for judging the wind, both for beginners and for experienced sailors.

After getting under way, the sailor must cope with two kinds of wind—true wind and apparent wind. True wind is the wind that is felt in a fixed location ashore. Its direction is registered ashore on flags, weather vanes, and meteorological instruments. Apparent wind is the wind a person feels when bicycling or riding in an open car. It is a combination of true wind and the wind caused by movement of the vehicle.

The wind felt by the crew of a sailboat and indicated by the masthead fly is apparent wind, the combined force of the true wind and the wind resulting from the motion of the boat. If a sailboat is traveling toward the

Fig. 4-23. Airfoil effect of a sail

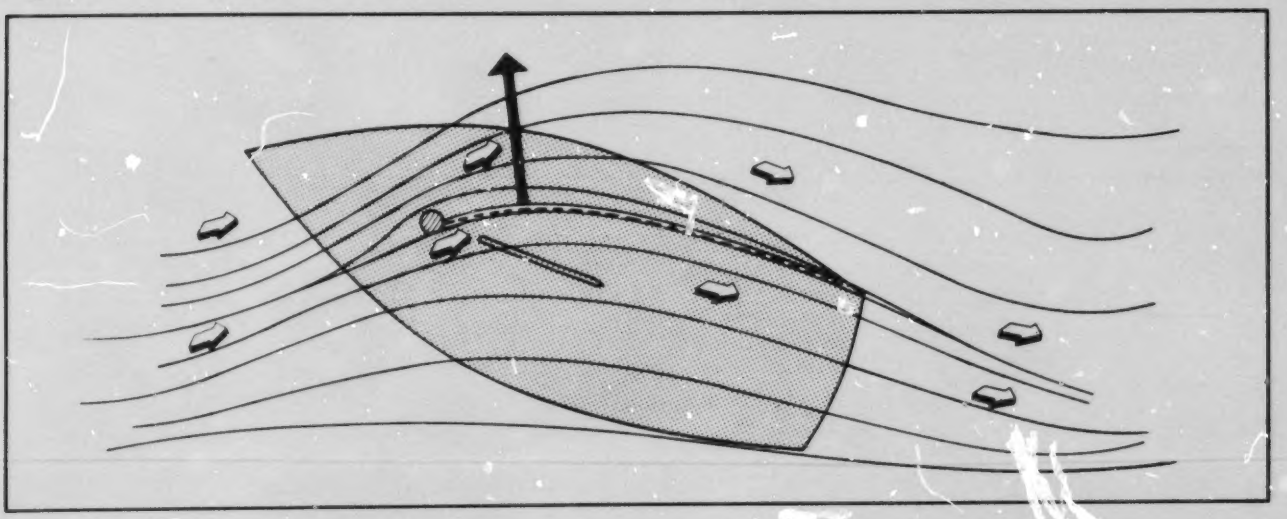
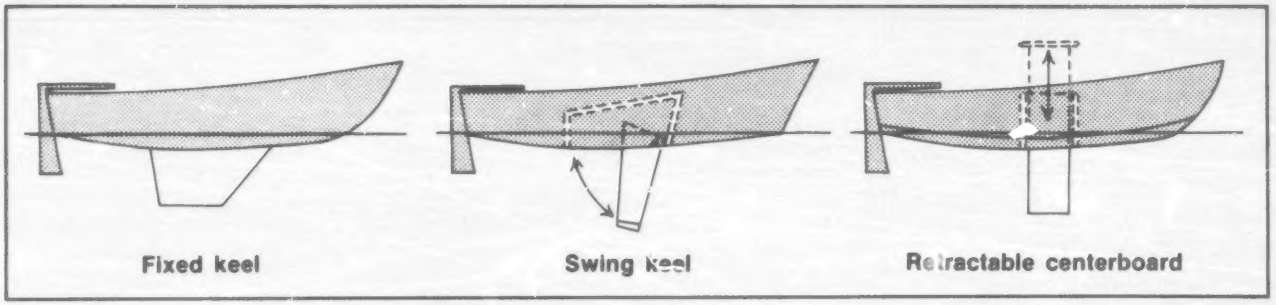


Fig. 4-24. Fixed keel, swing keel, and retractable centerboard



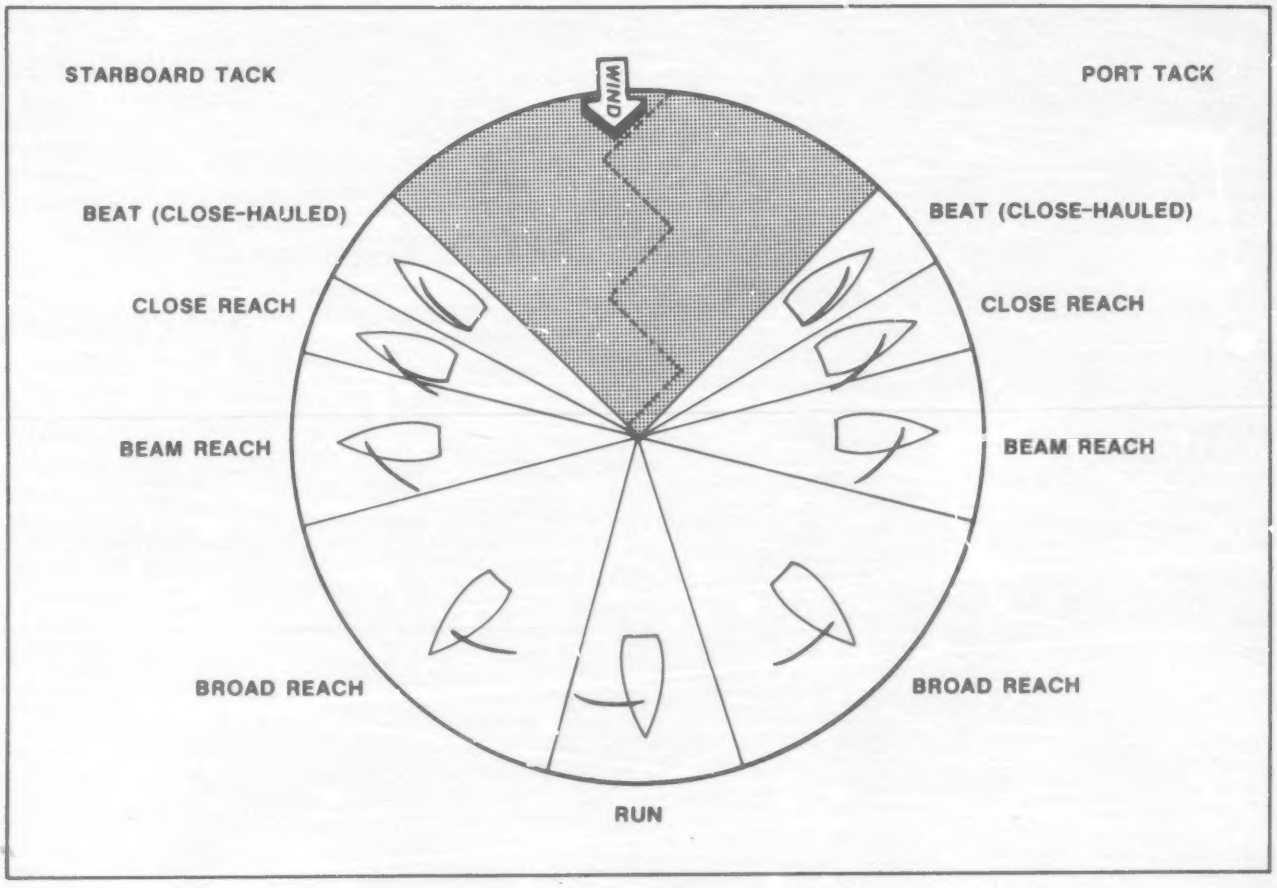
wind, the apparent wind seems to increase and to shift its direction toward the bow. If the boat is traveling downwind, the apparent wind may seem to die down, even though the boat is moving rapidly at almost the same speed as the wind.

The sailor must know the direction and velocity of the true wind, since it is the fuel that propels the sailboat; but he or she must learn to sail by the apparent wind.

Points of Sail

The various headings a boat can take in relation to the wind are called the points of sail. (See Fig. 4-25.) The sector that extends about 45 degrees each way from the eye of the wind is a dead zone in which a boat under sail cannot make headway. Reading around the "pie" both ways from the dead zone, the points of sail are as follows: close-hauled or beating; close reach;

Fig. 4-25. Points of sail



beam reach; broad reach; and running (sailing in the downwind sector). The points of sail are further defined as being on the port tack or the starboard tack, depending on which way the boat is traveling in relation to the wind. If the boat is beating, reaching, or running so that the wind is filling the sails from the port side, the boat is said to be beating, reaching, or running on a port tack. If the wind strikes the sails from the starboard side, the boat is said to be on a starboard tack.

Steering the sailboat so that it points farther away from the eye of the wind is called heading down, falling off, or falling away. Turning toward the wind is called heading up. To head down, the person at the helm puts the tiller up (to windward); to head up, he or she puts the tiller down (to leeward).

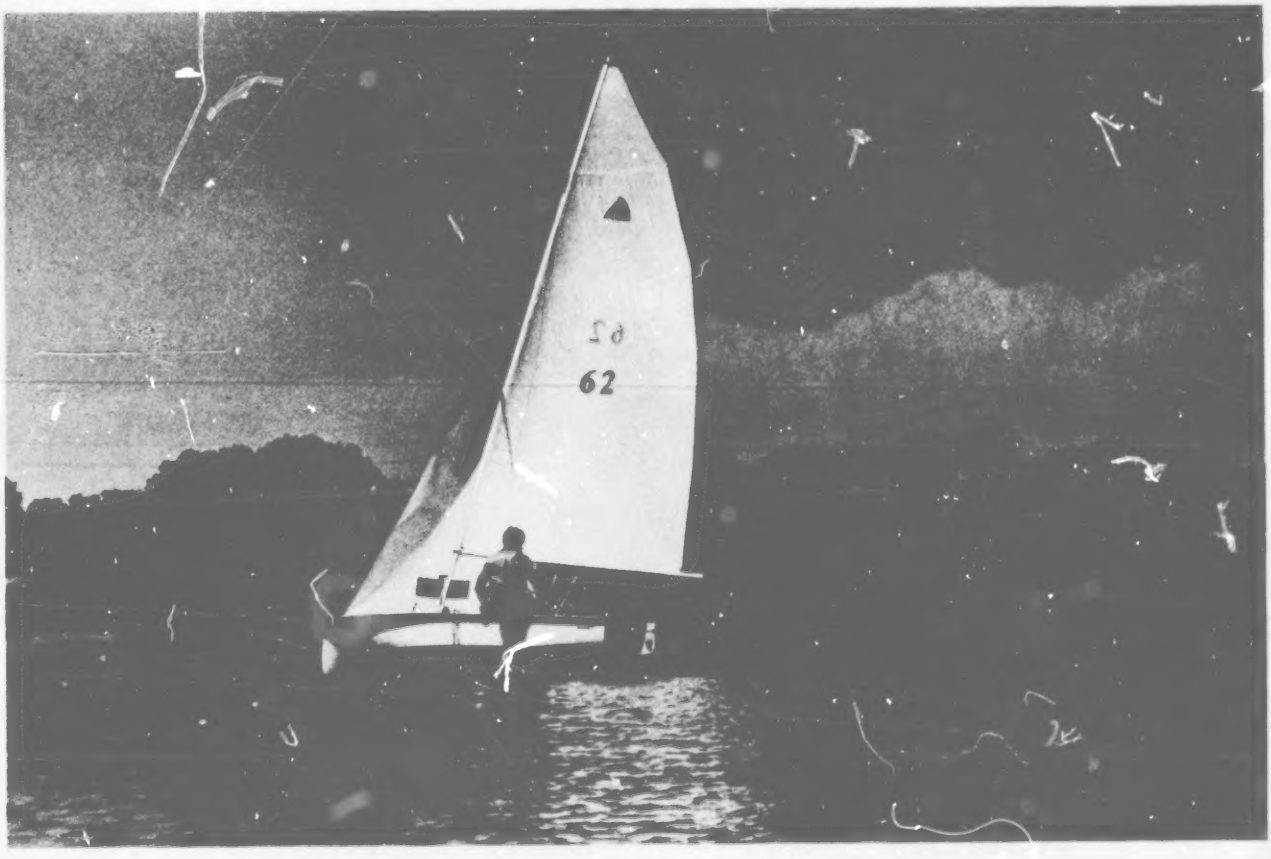
Turning the boat so far into the wind that the sails begin to flutter is called luffing or luffing up. Luffing up is like applying the brakes on a sailboat. In an emergency or when docking, you can bring your boat to a halt by simply luffing, then releasing the sheets (the lines that control the sails) to spill the wind. Another way to come to a quick stop if you are sailing close to the wind is to push the sail squarely into the wind.

The sail is the "motor" of your sailboat. To maintain speed when you are under way, pay close attention to the sail so you can keep it from luffing. Sit where you can see the sail easily, and stay ready to trim the sail if the wind shifts. For best efficiency, set the sail so that it is just inside the luffing position. Keep testing the sail for correct trim by letting it out until it just begins to luff, then pulling it in until the luffing disappears.

Angle of Heel

The angle of heel (the amount in degrees a sailboat leans from the vertical in the wind) must be controlled for safe and efficent sailing. On a small sailboat, the crew controls the angle of heel by "hiking out" (leaning outboard from the high-side rail to balance the boat). When hiking out, the crew should brace themselves against falls by means of toe straps or hiking straps. They should also keep their heads up so they can watch the sails and observe other traffic on the water. (See Fig. 4-26.)

Fig. 4-26. Heeling



In general, the shallower the angle of heel, the faster a sailboat will travel. For maximum speed, the craft should not be allowed to heel more than 30 degrees. If the angle of heel cannot be maintained within this limit, the sail must be let out to spill wind, or the sail must be reduced.

Besides slowing the boat, extreme heel puts great stress on the sails, the rigging, and the crew. Heeling more than 30 degrees also increases the danger of being blown over (a "knockdown," in sailing terms) and capsizing. At a heel of 50 degrees or more, a knockdown is imminent.

In a very light wind, an experienced skipper may purposely heel a sailboat 5 or 10 degrees to gain a little more speed. This slight amount of heel helps the sails fill and curve naturally in the light air and thus improves their aerodynamic efficiency.

Lee and Weather Helms

A sailboat is said to be well balanced if it is stable as a result of proper balance between the sail and the weight of the keel and the crew. A badly balanced boat is difficult to control, and because it requires constant correction of the rudder, it makes poor headway. In a light wind and with properly trimmed sails, a well-balanced boat will hold a straight course with only an occasional touch of the rudder. If a balanced boat tends to head into the weather (into the wind) under these conditions, the boat is said to have a weather helm. To maintain a straight course with a weather helm, the sailor must hold the tiller continually to windward (toward the wind). If the boat tends to fall away to leeward (away from the wind), the boat is said to have a lee helm, and the required corrective action is to hold the tiller to leeward.

A lee helm can be dangerous. If for any reason the tiller is abandoned, for example if the operator falls overboard, the boat will sail away downwind, jibing (zigzagging) wildly. For safety, most sailors prefer a slight weather helm; then if the tiller is abandoned, the boat heads into the wind and drifts to a stop.

Sailing a Course Windward

Sometimes your destination will be close to the wind's eye. If so, you must tack (sail a zigzag course) to work your way up the wind. (See Fig. 4-27.) You should sail each tack as close to the wind as possible. At the end of each tack, come about (make a 90-degree turn through the eye of the wind) and start a new tack.

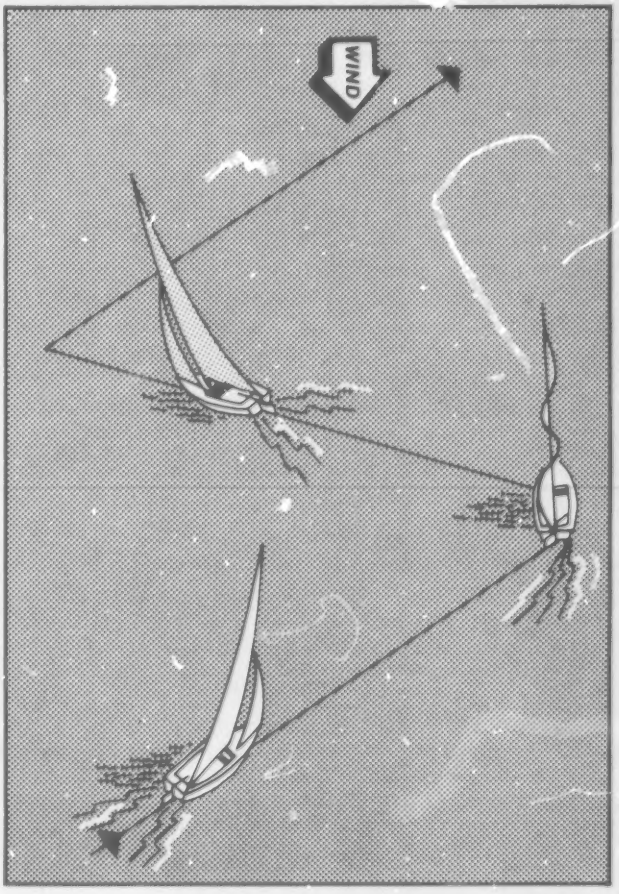
You may have to make short tacks to keep within a narrow channel, to adjust to wind shifts, or to keep a marker in view. Long tacks, however, are faster.

Coming About

Coming about is a simple maneuver used to reverse direction when on a reach or to change tacks when close-hauled. When coming about to change tacks, the skipper starts the turn by moving the tiller leeward. As the boat turns into the wind, the sails begin to lose their effect, but the boat's momentum carries it through. When the jib starts to luff, the crew eases (loosens) the sheets. With sails luffing, the boat turns through the eye of the wind, and the sails begin to fill again and swing to the other side. The jib sheet must be hauled in at this time to trim the jib. As the mainsail swings over, the sheets are trimmed to the new tack, and the crew moves to the other side of the boat to balance the heel. At the end of the maneuver, the skipper returns the tiller to the center position.

Coming about may fail if the boat is not trimmed properly or if it is traveling too slowly at the start of the maneuver. If the boat fails to complete the turn through the eye of the wind, it is said to be "in irons," a condition in which it will be almost impossible to steer or move.

Fig. 4-27. Tacking to windward



The Jibe

The jibe is a method of tacking downwind without coming about. (See Fig. 4-28.) It involves changing the mainsail from one tack to another, moving the boom almost 180 degrees across the boat. Jibes are of two types—controlled and uncontrolled. The controlled jibe is an easy maneuver that is safe in a light wind. An uncontrolled jibe is a dangerous accident that may damage rigging or injure a crew member. A sailboat on a dead run before a strong wind is especially vulnerable to an uncontrolled jibe.

Executing a controlled jibe. To execute a controlled jibe, procede as follows:

1. Begin by sailing before the wind with the boom out as far as it will go, but with the mainsheet kept under firm control. If the boat has a centerboard, lower the centerboard for more stability
2. Haul in the mainsheet until the sail is almost as tight as when beating. Keep the mainsheet clear so that it will run freely, and coil it loosely as you haul it in.
3. Release the jib sheet so that the jib swings freely.
4. Slowly put the tiller over from the boom. When the wind catches the mainsail, the sail and boom will abruptly swing over. To avoid being struck by the boom, keep low and warn the crew to do the same. As the boom swings through, have the crew move to the opposite side of the boat to balance the heel, taking care not to get tangled in the mainsheet. Let the mainsheet run out, but keep the boom clear of the shrouds. Keep the mainsheet under firm control to reduce the shock of the jibe. Snubbing the line around a cleat makes it easier to control. (For protection against rope burns, some sailors wear gloves when handling moving lines.)
5. Return the tiller to center to put the boat on the new course. You may have to put the tiller beyond center momentarily to check the turn. Then set the jib.

Some very small sailboats respond almost instantly to the wind and therefore require special jibing techniques. If the mainsheet is hauled in at the start of the jibe, the sailor may not be able to let the sheet out fast enough to prevent a broach (being turned broadside to the wind and capsized). Therefore, the sailor simply gives the sheet a tug to start the jibe and ducks his or her head. The boom then swings freely to the other side.

Avoiding an accidental jibe. To avoid an accidental jibe when sailing before a strong wind, experienced sailors usually tack rather than run dead ahead of the wind. When changing tacks, most prefer to ease up and come about rather than attempt a controlled jibe. Coming about in rough weather requires good judgment and good timing. Wind-driven waves usually run in an alternating pattern of large, steep waves followed by a series of shallow waves. The sailor must time the turn so that it can be completed while the waves are shallow. The centerboard should be down for added stability.

Using the Centerboard

Most small sailboats are equipped with a centerboard that can be lowered or swung down through a slot in the hull to control leeway (the sideways motion caused by the forces of wind, waves, and current). Mastery of the use of the centerboard is important to the sailor. The lowered centerboard keeps the craft from rolling excessively, reduces the angle of heel, and aids steering by reducing leeway and making the craft more responsive to the tiller.

Procedures for using the centerboard vary with each craft. The following are some general rules for use of the centerboard:

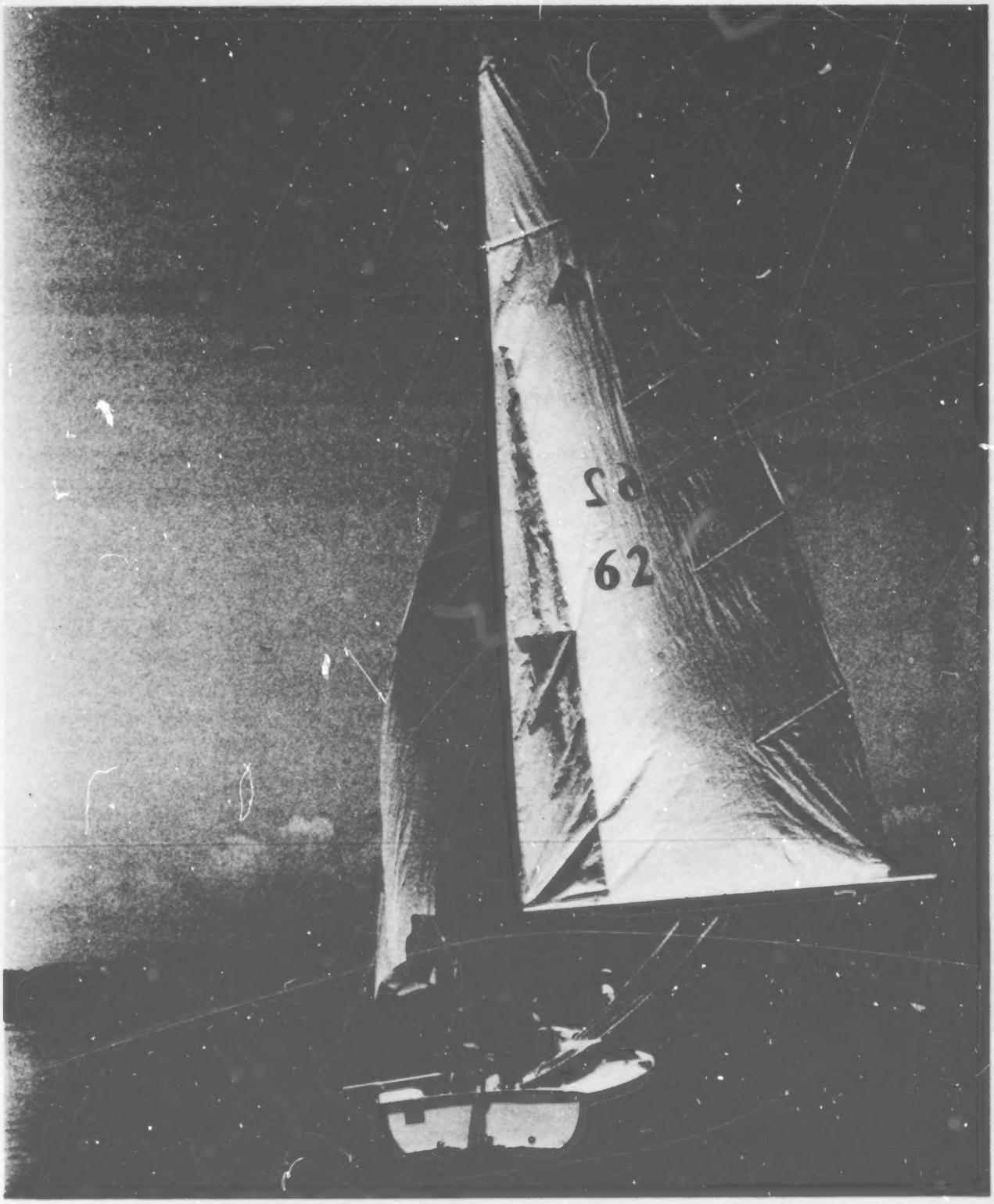
1. Keep the centerboard down to reduce leeway when sailing toward the wind or on a beam reach. The boat may sail faster with the centerboard up, but the angle of heel will be greater and the course will be irregular, making the boat harder to handle and ultimately wasting wind power.
2. Keep the centerboard up when sailing before the wind. Heeling and leeway are not problems on this point of sail; however, a slight lowering of the centerboard will aid steering and reduce weaving in rough water.
3. Put the centerboard down when coming about, jibing, or reacting to a luff. Otherwise, the boat will not respond well to the helm, and it may slip on the turn. In a strong wind, the boat may not complete the turn.
4. Instead of just using the rudder to correct a lee helm or an excessive weather helm, try changing the depth of the centerboard. By using less rudder you will reduce rudder drag, which will make for a faster ride.

Preventing Knockdowns and Capsizings

Some knockdowns and capsizings are unavoidable, but most are the result of carelessness or bad judgment. A sudden shift of the wind in a squall may knock over a sailboat. Some other more preventable causes of knockdowns and capsizings are carrying too much sail in a strong wind; jibing in a strong wind; improper balance, with the crew on the wrong side of the boat; and running before a strong wind with the crew too far forward. (The boat may dive into a wave and be unable to rise out of it.)

If bad weather develops or storm clouds are brewing, experienced boaters head for port. If you are

Fig. 4-28. Sailing downwind



caught out in a squall, take the following steps to prevent capsizing:

1. Head into the wind and release the sheets.
2. Lower the centerboard to increase stability.
3. Lower and secure the sails, and haul in and secure the mainsheets and the jib sheets. Securing the boom is also advisable. Stow all loose gear. Drop anchor if you are close to shore or in shallow water, but only if you have enough line to ensure that the anchor will hold. If you decide to remain under way, stream a line or drag a bucket over the stern to slow the boat, if necessary.

Information on how to recover from a capsize is provided in Chapter Six.

Keeping a Lookout

One final note to the person at the helm: Keep a sharp lookout for other boats and obstacles when you are under way, and remind your crew to do the same. The business of sailing is so absorbing that skippers often fail in this vital duty.

Sailboarding

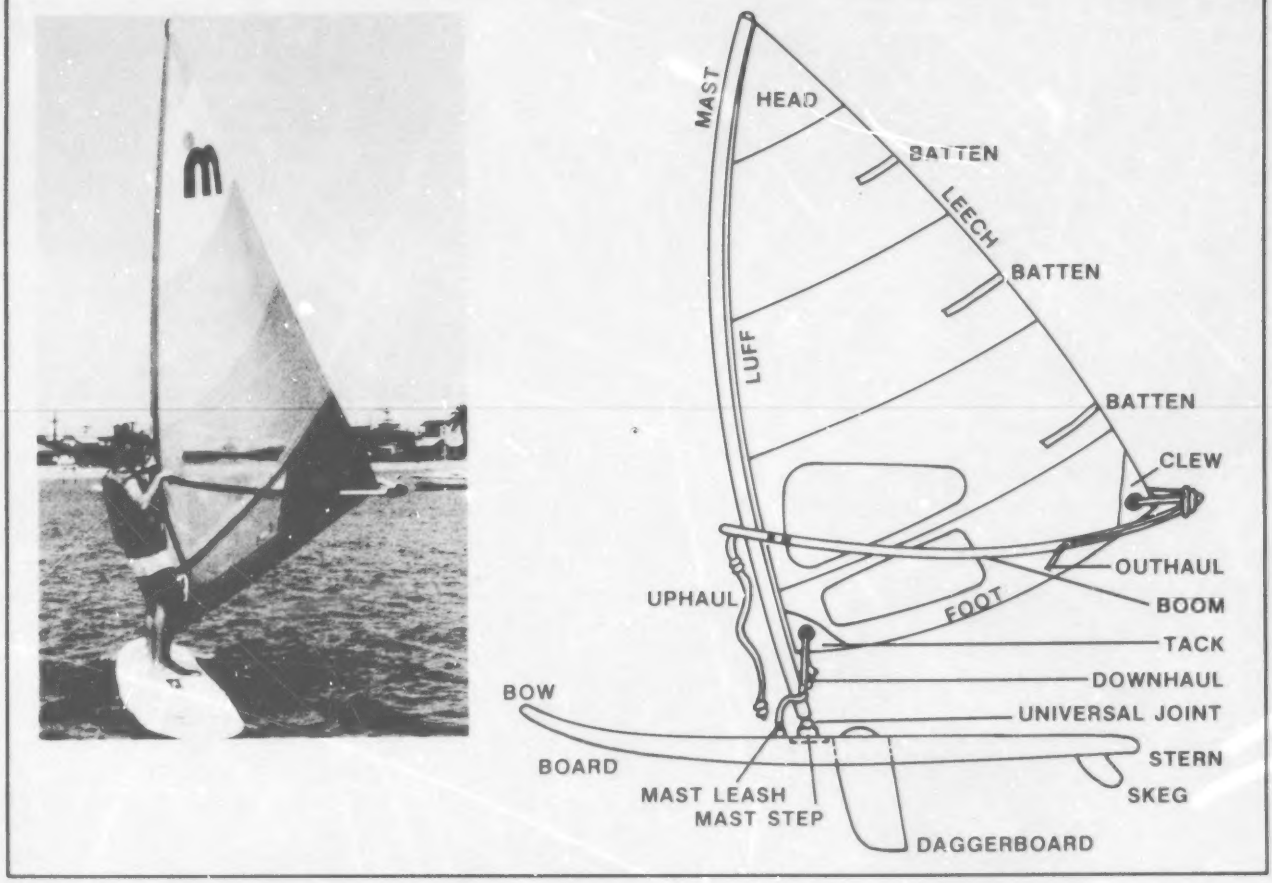
The sailboard is a hybrid watercraft that combines the features of a surfboard and a small sailboat. (See Fig. 4-29.) The craft has a centerboard but no rudder; steering is accomplished by changing the position of the mast and sail. A swiveling universal joint at the base of the mast permits the operator to turn the mast or lay it over in any direction by manipulating the wishbone boom.

Because of their light weight, generous sail area, and low water resistance, sailboards are nimble performers in even a moderate wind. They are also relatively inexpensive, easy to store and transport, and simple to rig. For these reasons, sailboarding is rapidly gaining favor with watersport enthusiasts throughout the world.

Learning the Sport

The fundamentals of sailboarding are not difficult to learn. After just a few hours of instruction, most beginners acquire enough skill to operate a sailboard safely in the calm waters of a small lake. Later on, with

Fig. 4-29. Parts of a sailboard



additional training and experience, a sailboarder can venture out on less sheltered lakes, bays, and coastal waters.

If you are trying a sailboard for the first time, choose a place to practice that is near shore and protected from strong winds and currents. Avoid open water until you have mastered the craft. A light, onshore wind is desirable for learning; it will allow you to practice sailing across the wind without fear of being blown far offshore.

Basic Requirements for Safe Sailboarding

Sailboarding is a physically demanding sport, and like all other kinds of boating it has its hazards. You should not attempt to operate a sailboard unless you are in good physical condition. Keeping a sailboard under control in a strong wind can strain the muscles and drain the energy of even the most experienced sailboarder. Since falls are inevitable, you must be prepared for cold dunkings and the strenuous task of pulling up the wet sail and mast. Also, you will probably have to swim to your capsized craft many times during most outings, especially in strong winds that tend to carry the board out of reach. Be careful to avoid overexertion and fatigue; tiredness takes its toll in the form of slowed responses and increased risk of accidents. If you become tired, lower the mast and rest on the board. Practice unrigging and furling (rolling up) the sail while under way as part of your self-rescue technique. If the wind gets too strong for safe sailing, or if it is not strong enough to get you out of a danger zone, you should furl the sail and center the mast on the board; then lie or kneel facing forward on the board and paddle to safety. (See Fig. 4-30.)

Here are some additional safety practices you should follow when sailboarding:

1. Always check the board and the sail rig before sailing. Most modern sailboards are equipped with a "mast leash" that keeps the board and the rig from drifting apart if they become separated in a knockdown. If your craft does not have one, attach a retention line to the board and the mast. You should also carry a light towline.
2. Wear appropriate clothing when sailboarding. Appropriate clothing includes deck shoes with nonslip soles for traction and foot protection; a wet suit for warmth; and a life jacket for flotation. Your wet suit will provide some buoyancy, but it is not a substitute for a life jacket.
3. Avoid overexposure to the sun. Remember that sunscreen lotions and creams tend to wash off after a few dunkings.
4. Before venturing out on a sailboard, inform yourself about local sailboarding regulations and sailing conditions. Avoid sailing in heavy weather.
5. Never sail alone. Let someone ashore know where you are going and when you will return.
6. Avoid areas that are crowded with swimmers, divers, persons fishing, or water-skiers. Stay clear of docking areas, marked shipping lanes, and channels. Keep alert for other watercraft.
7. Guard against falls in shallow water and wherever submerged objects may be present. If a fall is unavoidable, try not to fall headfirst, and try to direct your fall away from any part of the sailboard.
8. If you are in trouble, keep calm and stay with the board. Do not try to swim ashore. If you need assistance, wave your arms above your head.
9. Should the sail rig and the board become separated, swim for the board. The rig will stay in place; the board will drift downwind.
10. If you must recover or launch your sailboard through the surf, keep the craft between you and the beach to avoid being struck by the board.

Fig. 4-30. Self-rescue on a sailboard

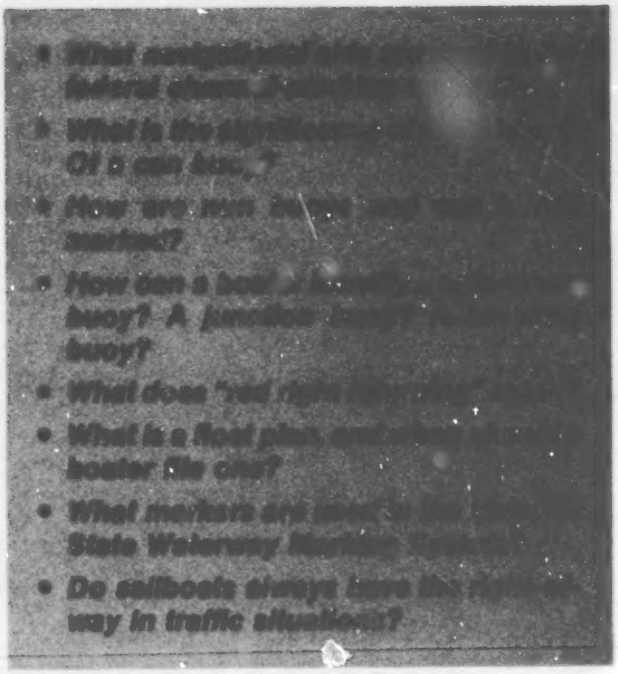
Rules of the Road

Federal and state boating authorities consider the sailboard to be a vessel and, therefore, subject to the rules of the road. Sailboarders can be cited and fined for violating those rules.

The continuing growth of sailboard traffic in California has resulted in new problems for enforcement personnel. Conflicts have arisen between sailboards and larger vessels, and violations of the rules of the road are common among inexperienced sailboarders. For these reasons, special zonings prohibiting or restricting the use of sailboards have been established on some water bodies. Sailboarders are members of the boating community, and as such they should respect the rights and privileges of all craft, large or small.

Chapter Five

Rules for Safe Boating



American society places a high value on life and provides protection for it in many ways, including the enactment and enforcement of laws dealing with every aspect of public safety. At the federal level, laws and regulations have been established to provide boaters with a safe system of navigation, to set safety standards for boats and associated equipment, and in general to help prevent boating accidents. The principal agency with powers of enforcement for federal boating laws is the U.S. Coast Guard. State and local boating laws are for the most part patterned after the federal laws and are in conformity with them. Every peace officer of the state or any of its political subdivisions has authority to enforce the California Boating Law. City and county boating ordinances are enforced by local peace officers.

The California Boating Law

Unlike automobile drivers, recreational boaters are not required to have an operator's license, but they are expected to know the laws and regulations that govern operation of their watercraft. You are presumed to have this knowledge if you are at the helm of any vessel, large or small, and ignorance of the rules will not be accepted as a defense if you are cited or arrested for failing to observe them. To provide California boaters with up-to-date information about the state's boating laws and regulations, the Department of Boating and Waterways publishes *ABCs of the California Boating Law*, a free booklet that is revised periodically to reflect changes in the law. A copy is included with this book.

Boaters must know and comply with the laws that govern operation of their watercraft, but laws alone cannot guarantee the safety of the waterways. Each year, boating accidents result in thousands of deaths and injuries and millions of dollars in property damage. Also, many costly search and rescue efforts are undertaken for boaters who become lost or stranded as a result of navigational errors, equipment failure,

lack of fuel, or failure to prepare for bad weather. The way to avoid becoming a boating statistic is to increase your boating knowledge and skills through proper training. Among the many excellent sources of boating safety instruction are the U.S. Coast Guard Auxiliary, the U.S. Power Squadron, the American Red Cross, and local schools and recreation departments. Safety information of value to boaters is also provided by the manufacturers of boats and associated equipment and by the media.

For additional information about boating safety classes in California, see the Department of Boating and Waterways pamphlet *Facts About Boating Safety Classes.*

Navigational Aids

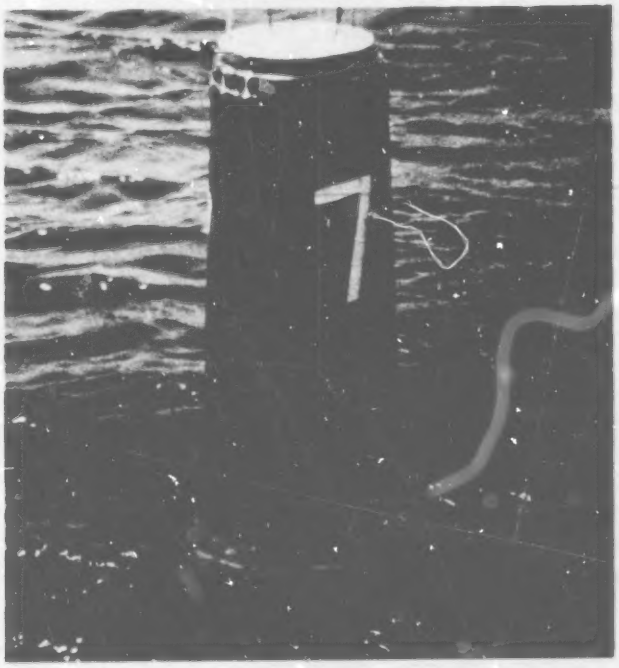
The waters of the United States are provided with navigational aids of many kinds, from lighthouses and loran installations to simple "daymark" signs displayed on pilings. Used in conjunction with nautical charts and light lists, the navigational aids enable mariners to move safely through channels and past isolated danger spots, follow marked routes, and determine their position at all times and in any weather. The navigational aids you will most often encounter and use on California's waterways are the channel buoys and other markers described in this chapter and in the *ABCs* booklet.

Lateral System of Buoyage (Federal System)

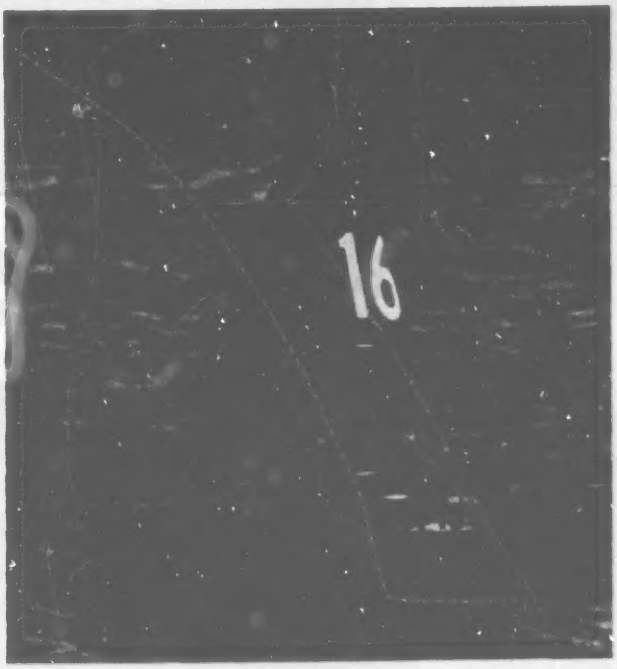
Buoys convey information by means of their shape, color, markings, and signaling devices (if so equipped). The buoys used in the federal channel-marking system are of two general types: large, tank-mounted units equipped with lights and/or sonic signaling devices (horns, whistles, bells, or gongs), and the smaller can buoys and nun buoys, which are so named for their distinctive shapes. Can buoys and nun buoys are unlighted, but like other buoys they may be equipped with optical reflectors and/or radar reflectors. (See figs. 5-1 and 5-2 in this chapter and the channel-marking diagram in the *ABCs* booklet.)

Port-hand and starboard-hand buoys. The buoys used to mark the left side (port side) of a channel, as seen by mariners heading in from seaward, are called port-hand buoys; those used to mark the right (starboard) side of the channel are called starboard-hand buoys. Port-hand buoys are painted either solid black or solid green (green will replace black by 1989); starboard-hand buoys are painted solid red. Port-hand buoys are odd-numbered and starboard-hand buoys are even-numbered, the numbers increasing toward the head of navigation. Port-hand buoys may be equipped with a flashing white or green light (all will be flashing green by 1989), or they may be can buoys. Starboard-hand buoys may be equipped with a flashing white or red

Fig. 5-1. Can buoy and nun buoy



Can buoy



Nun buoy

77

Fig. 5-2. Lighted buoy

light (all will be flashing red by 1989), or they may be nun buoys.

Marker buoys may differ in shape, but if you follow the color code when navigating a channel ("red right returning"), you will be on the safe route to your destination.

Safe-water buoys. The buoys used to mark mid-channels and fairways are called safe-water buoys. They may be passed on either side. Safe-water buoys are painted with black-and-white or red-and-white vertical stripes (all will have red-and-white stripes by 1989), and they may be equipped with a flashing white light (short-long flashes). They may also have a whistle or a bell. By 1989, all lighted and/or sonic safe-water buoys will be topped with a red sphere, as shown in the *ABCs* booklet. Safe-water buoys are not numbered, but they may have an identifying letter.

Junction buoys (preferred-channel buoys). Buoys used to mark channel junctions are painted with red-and-black or red-and-green horizontal bands (all will have red-and-green bands by 1989). If the topmost band is red, the preferred channel is to the left of the buoy; if the topmost band is black or green, the preferred channel is to the right. A junction buoy may be a lighted buoy, or it may be a can buoy or a nun buoy. If it is a lighted buoy, the color of the flashing light indicates the preferred channel—red if the preferred channel is to the left, and green if it is to the right. The flashing sequence may be a series of quick flashes interrupted about eight times per minute by a brief dark interval; or it may be a series of flashes occurring without interruption in a two-plus-one pattern (composite group flashing). Junction buoys are not numbered, but they may have an identifying letter.

Buoys having the same markings as junction buoys may be used to give warning of wrecks or other obstructions in a channel. If you are in doubt about the meaning of any buoy in the area where you are boating, consult the chart for the area. Remember too that buoys and other navigational aids are protected by law. Take care not to damage any aid or interfere in any way with its proper operation. Never tie up to any aid other than a designated mooring buoy.

Uniform State Waterway Marking System

The lateral system of buoyage was developed to aid navigation in waters that are under federal jurisdiction. However, many lakes, rivers, and other bodies of water used by boaters are located entirely within state boundaries and do not provide watercraft access to the sea. The Uniform State Waterway System has been devised for these waters, and it is in use in California and other states.

Two categories of markers are employed in the Uniform State Waterway Marking System—regulatory markers and aids to navigation. Regulatory markers are buoys or signs that give warning of dangerous or controlled areas, identify speed zones, and display other kinds of information. They are white with black lettering and orange borders. The principal aids to navigation on state waterways are channel side-marker buoys, which are solid red or solid black, and mid-channel buoys, which are painted with black-and-white vertical stripes. As in the federal lateral system, red buoys mark the right (starboard) side of the channel for vessels returning from the main water body, and black buoys mark the left (port) side of the channel. Starboard-hand buoys are usually nuns and port-hand buoys are usually cans, but the shapes may vary; the shape of a buoy has no significance in the Uniform State Waterway Marking System. Black buoys are odd-numbered and red buoys are even-numbered, and the numbers become higher as you return from the main body of water or proceed upstream. Red and black buoys are generally placed in pairs on opposite sides of a channel, indicating that boats should pass between the red buoy and its companion black buoy.

Sometimes a channel in state waters is marked with just a line of mid-channel buoys, with no left-side or right-side buoys. Mid-channel buoys may be passed on either side.

Importance of Filing a Float Plan

A float plan serves the same purpose for a boater embarking on a cruise that a flight plan does for an airplane pilot. Left with a friend or other reliable person ashore, the float plan greatly increases your chances of being located and helped if an emergency situation prevents you from returning on schedule. A copy of the float plan and accompanying checklist developed by the Department of Boating and Waterways is included in the *ABCs* booklet.

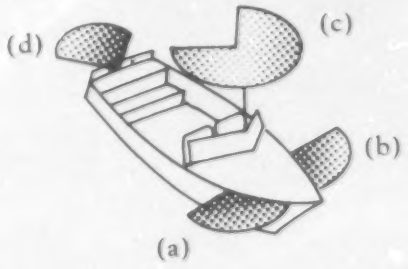
Be sure to inform the person holding your float plan about any last-minute changes in the plan, and be sure that he or she knows how to contact the appropriate authorities if the need arises. Stick to your float plan once you are under way, and be sure to cancel it when you return.

Study Guide

The remainder of this chapter consists of a self-test based on information contained in *ABCs of the California Boating Law*. Read the booklet through; then check your understanding of its contents by completing the self-test exercises. Write your answers in your notebook or on scratch paper. Since the purpose of the self-test is to help you learn the rules that govern boating in California and not to grade your performance, you may keep the *ABCs* booklet at hand to recheck any information you need as you complete the test items.

Boat Registration and Equipment

1. Where would you go to register a boat?
2. Which of the following vessels need not be registered?
   (a) Kayak
   (b) Oar-propelled raft
   (c) Jet-drive motorboat
   (d) Fishing boat powered by a small outboard motor
   (e) Sailboat less than 8 feet (2.44 metres) long
   (f) Vessel documented by the U.S. Coast Guard
   (g) Sailboat equipped with an auxiliary engine
   (h) Houseboat moored at a marina
3. The equipment requirements for pleasure boats are determined mainly by the length of the boat and the means of propulsion used. What are some other factors that influence equipment requirements?
4. How are the following watercraft classified for purposes of equipment requirements?
   (a) A sailboat operating under auxiliary power
   (b) A sailboat operating under both sail power and auxiliary power
   (c) A rowboat powered by a small outboard motor
5. If you own a boat or have one in mind that you would like to own, describe its type, length, and means of propulsion (for example, a 24-foot [6.22-metre] inboard runabout powered by an enclosed gasoline engine, or an 18-foot [5.49-metre] sailboat equipped with a small auxiliary outboard motor). Then make a list of the legally required equipment and recommended additional equipment for the craft. Identify the legally required items by means of an (R). In making the list, keep in mind that some equipment requirements vary according to where and when you intend to operate your boat.
6. All boats must carry at least one Coast Guard approved personal flotation device (PFD) in serviceable condition for every person aboard. List three kinds of defects that would make a PFD unserviceable.
7. What type of PFD provides the greatest protection in the event of a boating accident?
8. Water-skiers being towed are considered to be "persons on board" for purposes of PFD requirements. Does a ski belt meet the PFD requirement for a skier under tow?
9. Why should a buoyant cushion never be worn like a backpack?
10. All vessels must display required running lights between sunset and sunrise and during periods of restricted visibility. The vessel shown below is a motorboat less than 12 metres (39 ft. 5 in.) long equipped for use in international and inland waters. Identify each light (a, b, c, and d) by name, color, visible range, and degree of visibility.



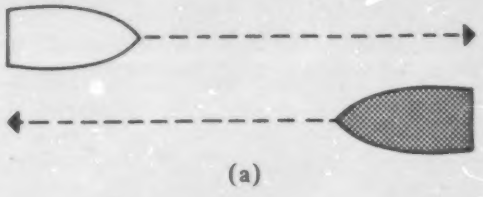
11. Referring again to the motorboat in the previous problem, what alternate method may be used to display the side lights? What alternate method may be used to display the stern light?
12. An anchor light must be what type and color?
13. What is the smallest size fire extinguisher that is approved for use aboard pleasure boats?
14. Most boats operating on coastal waters must carry visual distress signals at all times. What are the exceptions to this rule?
15. What is meant by the term "coastal waters"?

General Boating Rules

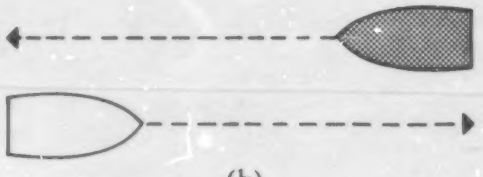
1. If a boat is being operated with an unsafe condition, a Coast Guard boarding officer or other law-enforcement officer can order the vessel to the nearest safe moorage and require it to stay there until the unsafe condition is corrected. List some unsafe conditions that you think might result in such action.
2. Give five examples of reckless or negligent operation of watercraft.
3. What is the maximum permissible speed for a boat under way in each of the following locations?
   (a) Within 100 feet (30.48 metres) of a bather or swimmer
   (b) With 200 feet (61 metres) of a swimming area in use (bathing beach, swimming float, diving platform, or life line)
   (c) Within 200 feet (61 metres) of a landing where boats are tied up
4. Operating a motor vehicle while under the influence of alcohol or any drug that affects your driving ability is a punishable offense. Are you also breaking the law if you operate a boat while under the influence?
5. What must the operator of a boat do if he or she is involved in a boating accident?
6. Under what conditions must a boater who is involved in an accident file a written accident report, and with whom must it be filed?
7. Waterskiing is a team sport involving three participants: the skier, the powerboat operator, and one other person. What is the function of the third team member, and at least how old must he or she be?
8. A boater who is in distress (that is, in grave and imminent danger) and whose vessel is equipped with a radiotelephone may transmit the international distress call to summon help. What is the international distress call, and what channel would a boater use to transmit it?
9. List five other kinds of signals that are recognized as indicating that a boater is in distress and in need of assistance.
10. If you have transmitted a distress call on your marine radiotelephone, what should you do as soon as the emergency is over?

Rules of the Road

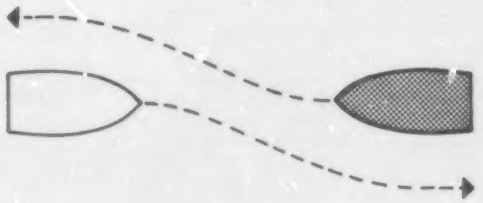
1. Give the meaning of each of the following navigational signals for power vessels:
   (a) One short whistle blast
   (b) Two short blasts
   (c) Three short blasts
   (d) Five or more short blasts
   (e) One prolonged blast (4 to 6 seconds)
2. How should a powerboat operator answer an intended maneuvering whistle signal sounded by another powerboater?
3. Study the meeting situations illustrated in (a), (b), and (c) below, and identify the navigational signal that should be sounded by the black boat and the white boat in each situation.



(a)

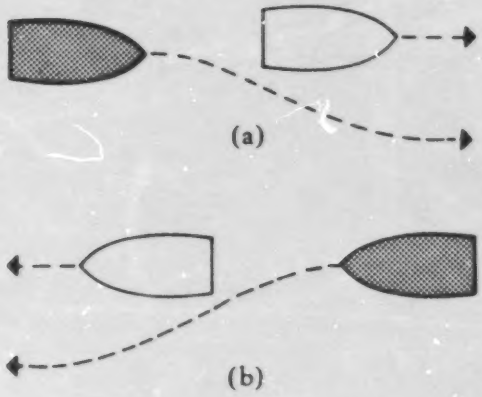


(b)



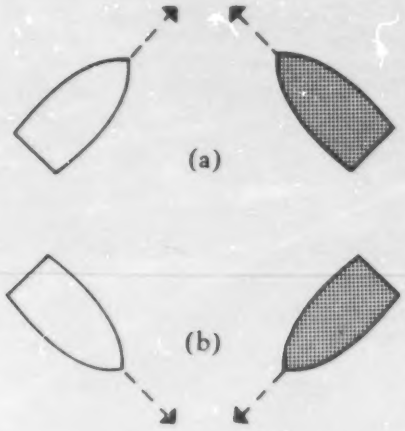
(c)

4. In the overtaking situations illustrated in (a) and (b) below, what signal should be sounded by the overtaking powerboat, and how should the powerboat being overtaken reply?



5. When any vessel is overtaking another, what action must be taken by (a) the overtaking vessel; and (b) the vessel being overtaken?

6. In the crossing situations illustrated in (a) and (b) below, identify the stand-on vessel and the give-way vessel.



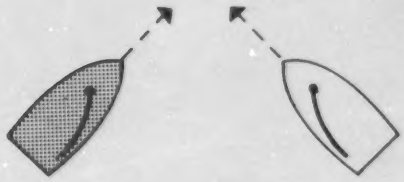
7. Referring again to the crossing situations in the previous problem, how should the give-way vessel alter its course to keep clear of the stand-on vessel?

8. Is there any situation in which the stand-on vessel should alter its course or speed?

Rules for Sailboats

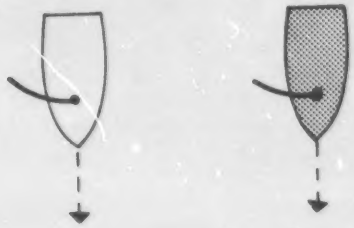
1. When two sailboats are approaching each other in a meeting or crossing situation where there is risk of collision, one must keep out of the way of the other, the right-of-way being determined by the direction of each vessel in relation to the wind. In the drawing below, identify the sailboat that has the right-of-way

2. Assume that the sailboats in the crossing situation illustrated below are close-hauled on a port tack and a starboard tack, respectively. Which sailboat has the right-of-way?

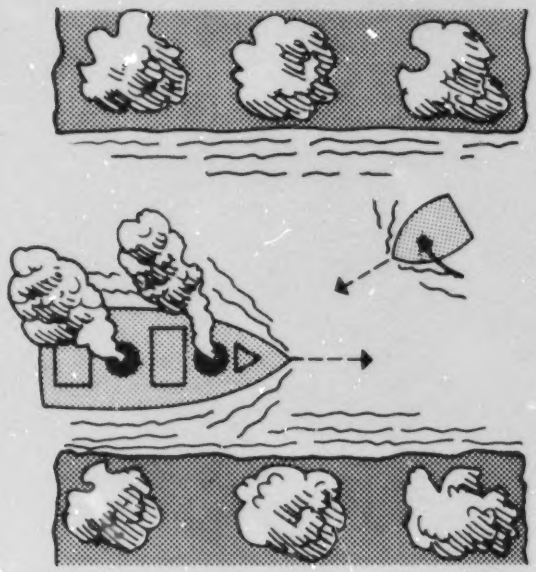


3. If the boats in the previous problem are sailing downwind instead of on a windward tack, which one has the right-of-way?

4. The boats shown below are sailing on a broad reach. Identify the windward vessel and leeward vessel and the stand-on vessel and give-way vessel.



5. In the meeting situation illustrated below, which vessel in the channel is the stand-on vessel?



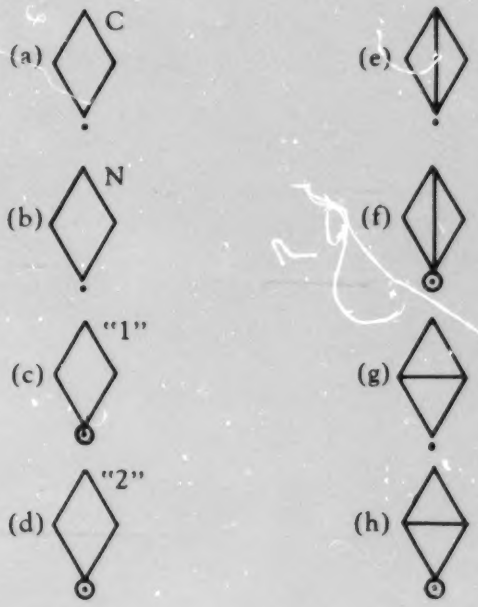
Fog Signals

1. Interpret each of the following signals sounded by vessels in or near areas of restricted visibility:
   (a) One prolonged blast repeated at intervals of not more than two minutes
   (b) One prolonged blast followed by two short blasts, repeated at intervals of not more than two minutes
   (c) Two prolonged blasts about two seconds apart, repeated at intervals of not more than two minutes
   (d) A bell rung rapidly for about five seconds at intervals of not more than one minute
2. What is the duration of a short blast? Of a prolonged blast?
3. What should you do if you are under way in or near an area of restricted visibility and hear a fog signal from another vessel apparently forward of your beam?

Lateral System of Buoyage

1. What does the expression "red right returning" mean to a mariner?
2. What are the two general types of buoys used in the federal channel-marking system?
3. Buoys used to mark the sides of a channel may be even numbered or odd numbered. Which ones are even numbered, and which ones are odd numbered?

4. Buoys and other navigational aids are indicated on nautical charts by means of symbols, which are usually accompanied by letters, numbers, and/or brief notations. Identify each of the following symbols for channel-marking buoys:



5. Certain navigational aids used in the lateral system of buoyage are undergoing modifications that are expected to be completed by 1989. Explain how the following characteristics of federal marker buoys are being changed:
   (a) Color of flashing lights on port-hand and starboard-hand buoys
   (b) Color of paint on port-hand buoys
   (c) Color of vertical stripes on mid-channel buoys
   (d) Color of horizontal bands on junction buoys
   (e) Flashing sequence of lighted junction buoys

Uniform State Waterway Marking System

1. On what bodies of water are the buoys and signs of the Uniform State Waterway Marking System used?
2. What color scheme is used on regulatory markers in the Uniform State Waterway Marking System?
3. Red buoys and black buoys are used to mark channel limits in the Uniform State Waterway Marking System. How are these buoys usually placed in a channel?

4. What alternate method is sometimes used to mark a channel for safe passage in state waters?

5. Shown below are some types of regulatory markers and navigational aids used in state waters. Match the names with the drawings.

Danger marker
Controlled-area marker
Boats-keep-out marker
Marker on piling
Marker on special-purpose buoy
Dual-purpose marker on land
Information sign
Left-side channel buoy
Right-side channel buoy
Mid-channel buoy
Mooring buoy

(a)

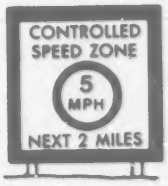
(b)

(c)

(d)

(e)

(f)



(g)

(h)

(i)

(j)

(k)

Chapter Six

Heavy Weather and Emergency Procedures

- What is a boater's best defense against heavy weather?
- What should a boater do at the first sign of an approaching storm?
- How can a boater "lay to" in a storm?
- What is the cause of most fatalities in boating accidents?
- How can a capsized sailboat be righted?
- What should a canoeist in white water do if the craft capsizes?
- Why is keeping a proper lookout important?
- Why should boaters stay with the craft if it capsizes?

Heavy Weather

Checking weather forecasts and keeping alert to changing weather conditions is part of every experienced boater's routine. However, storms cannot always be predicted with great accuracy, so unless you are sure that you and your boat can take the stress of an encounter with heavy seas, you should stay ashore in uncertain weather. Bringing a small boat safely through a storm can be a real challenge, especially for a beginner. It requires a cool head, skillful handling, and a sound, properly equipped craft.

If you are new to boating and are caught in your first storm, you may be tempted to just run for the nearest port. That would have been an excellent idea before the storm arrived, provided that a safe harbor were near enough to be reached in time, but now it may be too late. If the increasing storm has made running for shelter too risky, you may have to stay where you are and ride out the bad weather. Usually the best way to do this is to "lay to" (keep the boat stationary, with the bow facing into the wind). If your craft is a powerboat and you have an adequate supply of fuel, you can lay to by turning into the wind and using just enough power to keep the boat from making headway. If you run out of fuel, or if you are skippering a sailboat, you can lay to by putting out a sea anchor. (See Fig. 6-1.)

At the first sign of bad weather, everyone aboard who is not already in a life jacket should get into one. All loose gear should be lashed down or stowed in a locker, and the weight of the gear and the crew should be kept low in the boat for stability. The galley should be secured and all fires put out. All hatches and portholes should also be secured.

Waves on Open Water

Waves on open bodies of water (lakes, bays, and oceans) are caused mainly by the wind. Wave action is always present in some degree on open water, although it might not be noticeable if the wind is light to moder-

ate. Long after a strong wind dies down and loses its driving force, the waves it has set in motion continue in the form of swells (smoothly rising and falling waves with rounded crests and troughs). Long swells with gentle slopes seldom give much trouble to small craft, which simply ride up and down on the swells without any violent motion. However, large swells produced by a storm may travel hundreds of miles from the storm area, retaining much of their size and energy as they advance toward shore. Swells may therefore begin to appear where you are boating even on a calm day, and they may build rapidly. The hazard is greatest in shallow waters and tidal areas, where swells tend to bunch up and increase in height.

Emergency Procedures

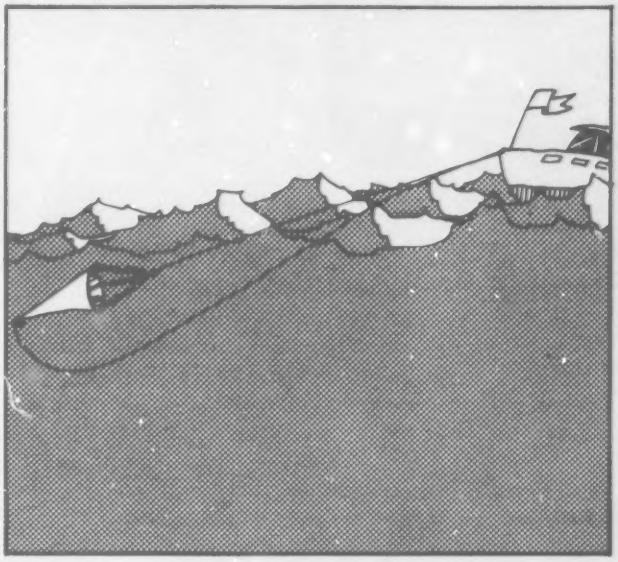
An emergency is an unforseen event that requires immediate corrective action. Most boating emergencies start small and are not difficult to cope with in their early stages. Unless the emergency gets out of hand because too many things are going wrong at once, a skipper can usually gain control of the situation by keeping a cool head and following standard emergency procedures. For example, an emergency exists if a passenger falls overboard, but it is likely to be only a minor emergency if (a) the victim is wearing a life jacket; (b) the victim is kept in sight during the rescue effort; (c) the skipper returns promptly to the victim and approaches him or her cautiously from the leeward side, with power off; and (d) the victim is checked for possible injuries before being lifted aboard.

In the stress of an emergency, many persons fail to recognize that a simple solution to the problem may be available. If for example your boat has sustained damage in rough water but you are still able to make way, the best thing to do may be to head for a safe landing on the near shore, even though the landing spot may be less than ideal and at a considerable distance from your starting point. This will get you out of the water and in a sheltered location in the shortest possible time, and it will make it easier for you to get any help you may need to make repairs or treat the injured.

Capsizings

Most of the fatalities that occur in boating accidents are the result of capsizings. Having your boat turn over in the water can be a frightening experience, especially in heavy weather, but it need not be a disastrous one. In fact, most experienced canoeists, kayakers, and operators of small sailboats regard capsizings as almost a routine occurrence, and some even consider them part of the fun. Since most small craft have enough extra flotation to keep them afloat even when they are full of water, the safest thing to do if your boat capsizes is to stay with the boat. This rule should be broken only in extreme cases, as when the boat is drifting

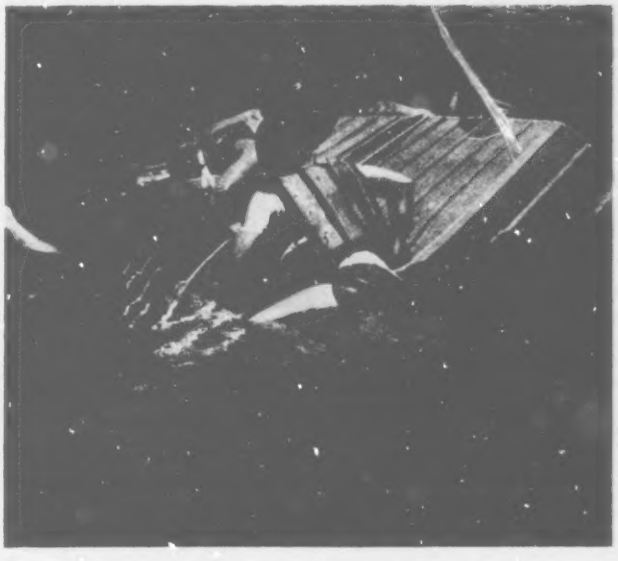
Fig. 6-1. Using a sea anchor



rapidly toward a danger area. Have everyone hold on to or climb onto the overturned craft; rescuers can spot an overturned boat much easier than they can a person's head in the water. (See Fig. 6-2.) More important, attempting to swim to shore often leads to drowning. Distances are hard to judge on the water, and the shore may be much farther away than it seems. A swimmer may become exhausted before reaching shore, especially if the water is cold.

The danger of overloading. The principal cause of capsizing is overloading. An overloaded boat rides low in

Fig. 6-2. Staying with the boat



the water, and it is difficult to steer. This combination of reduced freeboard and sluggish response makes the boat highly vulnerable to swamping and overturning, especially in rough water. The danger is even greater if the load is not properly distributed or secured. Large vessels have been known to capsize as a result of shifting cargo or a rush of passengers to one side.

The capacity plate of a boat indicates the maximum weight and number of passengers the craft is designed to carry under normal conditions, but this information must be used with good judgment. It is logical to assume, for example, that less weight should be carried if heavy weather is a possibility. If you have any doubt about how much weight you can safely put into a boat, you should heed the advice of experienced sailors: "If a boat *feels* overloaded, it *is* overloaded."

Avoiding swamping. A boat can also be made unstable and hard to handle by an accumulation of water in the bilge. Any tendency of the boat to roll will be increased by the shifting mass of the water. A cubic foot (.028 cubic metre) of water weighs about 62.5 pounds (28.3 kilograms). If a small boat is running in a moderate to heavy sea and has as little as 2 cubic feet (.056 cubic metre) of water sloshing about in the bilge, the rolling action of the boat could become severe enough to result in its capsizing or swamping. Since bilge water must not be allowed to build up, bailing equipment of some type is essential for all craft.

Unwanted water can enter a vessel in many ways. It can arrive in the form of rain, come over the bow in the form of spray, or wash over the gunwales if the boat has too little freeboard or is rolling excessively. It can also break over the transom if a high swell overtakes the boat in a following sea. And of course it can enter through a crack or other defect in the hull. If you are out on the water and a leak develops that requires constant attention, you should try to find its source, but unless the leak is becoming threatening you should head for shore and make any needed repairs there. To locate the leak, begin by checking the seams of the hull. Check corners and sharp angles, including the chines (the intersections of the sides and bottom of the boat). On a sailboat, check also around the centerboard trunk and the mast step.

Cracks or holes resulting from a collision or grounding are common, especially with fiberglass hulls. Locating and repairing a leak in a fiberglass or aluminum craft can be difficult. In most cases specialized equipment is needed to make a permanent repair. A satisfactory temporary patch can often be made with duct tape, but getting the area around the leak dry enough for the tape to adhere can be a problem. The best place for the tape is on the outside of the craft so that water pressure will push it against the hull.

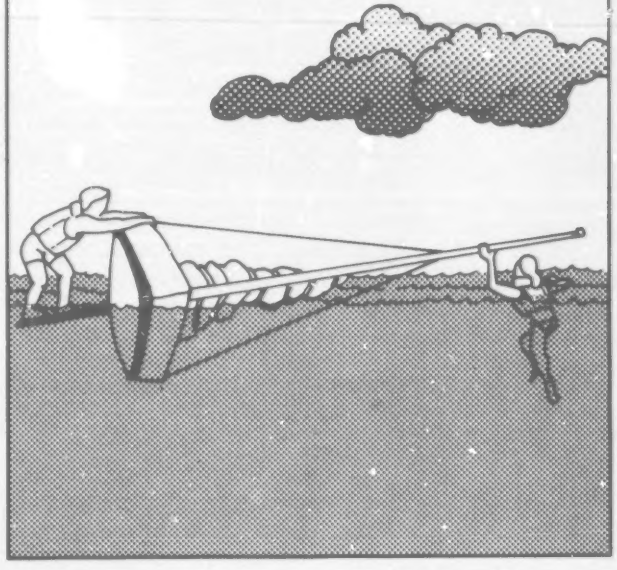
Capsized sailboat. As in any capsizing, the first thing to do if your sailboat turns over is make sure everyone is accounted for and in a life jacket. Instruct everyone to stay with the boat, and remind them to avoid making unnecessary swimming movements, which could get their legs tangled in submerged lines. Gather any floating gear that is within safe reach and stuff it in a sail bag, but resist the temptation to swim off in pursuit of nonessential items that are drifting away.

A capsized centerboard sailboat will usually remain on its side, and it may even right itself if the halyards are released and the sails are brought in close to the deck. Usually, however, the skipper and crew will have some additional work to do to get the boat upright again. The boat should be righted and bailed as soon as possible, since if it is left unattended it may turn completely over, with the mast pointing straight down. Allowing the boat to "turn turtle" this way can complicate a routine rescue, especially if the boat is in relatively shallow water and the tip of the mast buries itself in the mud.

The following procedure for righting a capsized sailboat is general, but it can be the basis for your drill with a capsized boat:

1. Release and lower the sails, and secure the free ends of the halyards to cleats.
2. Have one or two crew members climb onto the extended centerboard and hold onto the gunwale to start the recovery. At the same time, another person can assist by lifting up the tip of the mast. (See Fig. 6-3.)
3. When the mast is again pointing skyward, have the crew begin bailing while they remain along-

Fig. 6-3. Righting a sailboat



side and steady the craft. (The boat will be very unstable until some of the water has been bailed out.)

4. When enough water has been removed to increase the freeboard to about 6 inches, have a lightweight member of the crew climb in over the stern and finish bailing. Then the sails can be raised again.

Capsized canoe. The light weight, narrow beam, and shallow draft of a canoe make it especially vulnerable to capsizing. Canoeists must therefore be well practiced in the techniques of recovering from a capsize, and they should also know how to rescue other boaters in their party whose canoe may have capsized. Wearing a life jacket is a must.

In the event your canoe capsizes or becomes swamped, stay with the craft if possible; a canoe should float even if it is full of water. Abandon the craft only in extreme circumstances, for example if you are approaching a dam or waterfall or if a strong wind is pushing the craft out of your reach. Do not attempt to chase a canoe that is being blown onto open water; get rid of heavy clothing and use an energy-saving stroke to swim to shore.

If you capsize in rapids or white water, hold onto the upstream end of the canoe. That way, the canoe will help keep you afloat and protect you from being slammed onto rocks. Keep your feet and legs together and pointed downstream. Do not attempt to stand up in rapidly moving water unless it is too shallow for swimming.

Getting back in. If you fall out of a canoe in deep water and the canoe remains upright and afloat, the easiest way to get back in is as follows:

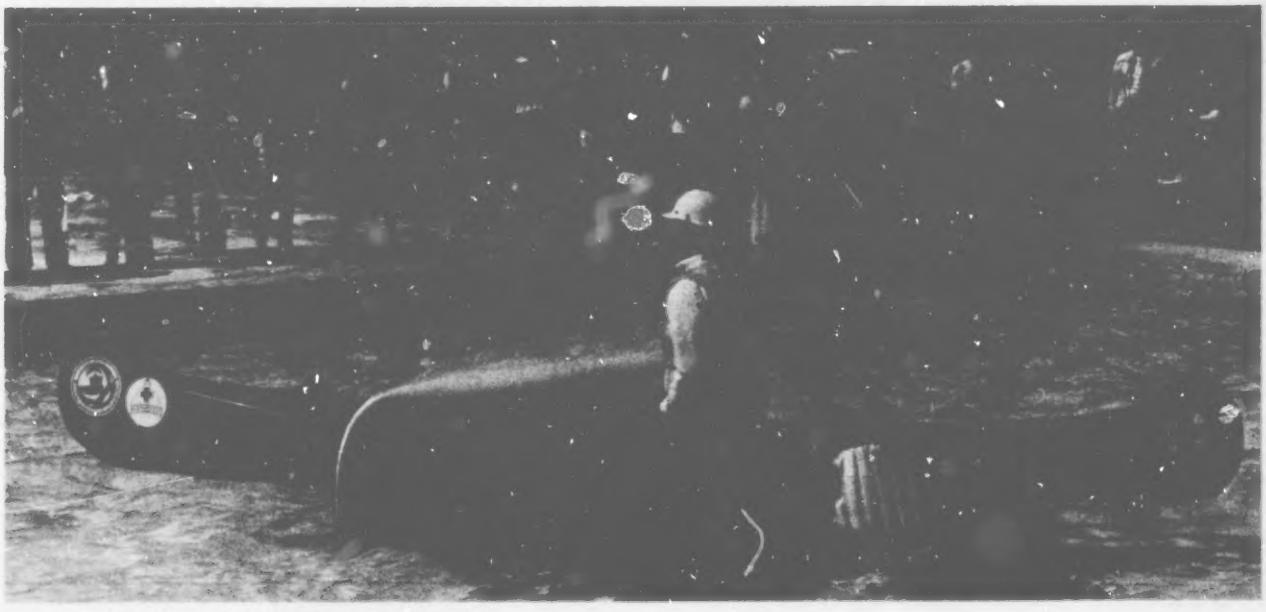
1. Reach over the side of the canoe near amidships, place your hands on the bottom of the canoe near the centerline, and press down.
2. Kick your feet to bring your legs to the surface, and push your upper body well into the canoe.
3. Keeping your weight low, roll your body into a sitting position on the bottom of the canoe, with your legs still over the side.
4. Let the canoe settle; then swing your legs inside.

You can also use the above method to reenter a swamped canoe, provided that you do so carefully. A canoe that is full of water capsizes easily.

Canoe rescue. To come to the rescue of another crew whose canoe has capsized, proceed as follows:

1. Draw alongside the capsized canoe, and have the persons in the water hang onto the bow and stern of your rescue canoe to help stabilize it.
2. Lift the bow of the swamped canoe to empty it of as much water as possible.
3. Hold the swamped canoe at right angles to your canoe; then quickly roll it upside down and pull it over your gunwales until it is balanced with both ends out of the water. (See Fig. 6-4.)
4. Roll the saved canoe upright and return it to the water; then bring it alongside the rescue canoe.
5. Hold the two canoes parallel by holding their gunwales tightly together at amidships, and have the other crew reenter their craft one at a time.

Fig. 6-4. Canoe rescue



Fires and Explosions

Every year, boating accidents involving fires and explosions result in many personal injuries and a vast amount of property damage. (See Fig. 6-5.) Most fires and explosions on pleasure boats occur at dockside during or shortly after refueling, and accidents of this type can be prevented by observing the fueling precautions outlined in Chapter Four.

A fire that breaks out when you are afloat must be dealt with promptly and effectively, since you are likely to be trapped if the fire escalates. You should without delay get everyone into a life jacket. Slow or stop the boat, and turn it so that the fire is downwind. If the fire is on wood or cloth, you will probably be able to put it out with water from your bailing bucket. Never try to put out an oil, grease, or gasoline fire with water; you will just spread the fire. Use your fire extinguisher instead, and use it also on electrical fires. If the fire is in the engine compartment, shut off the fuel supply immediately.

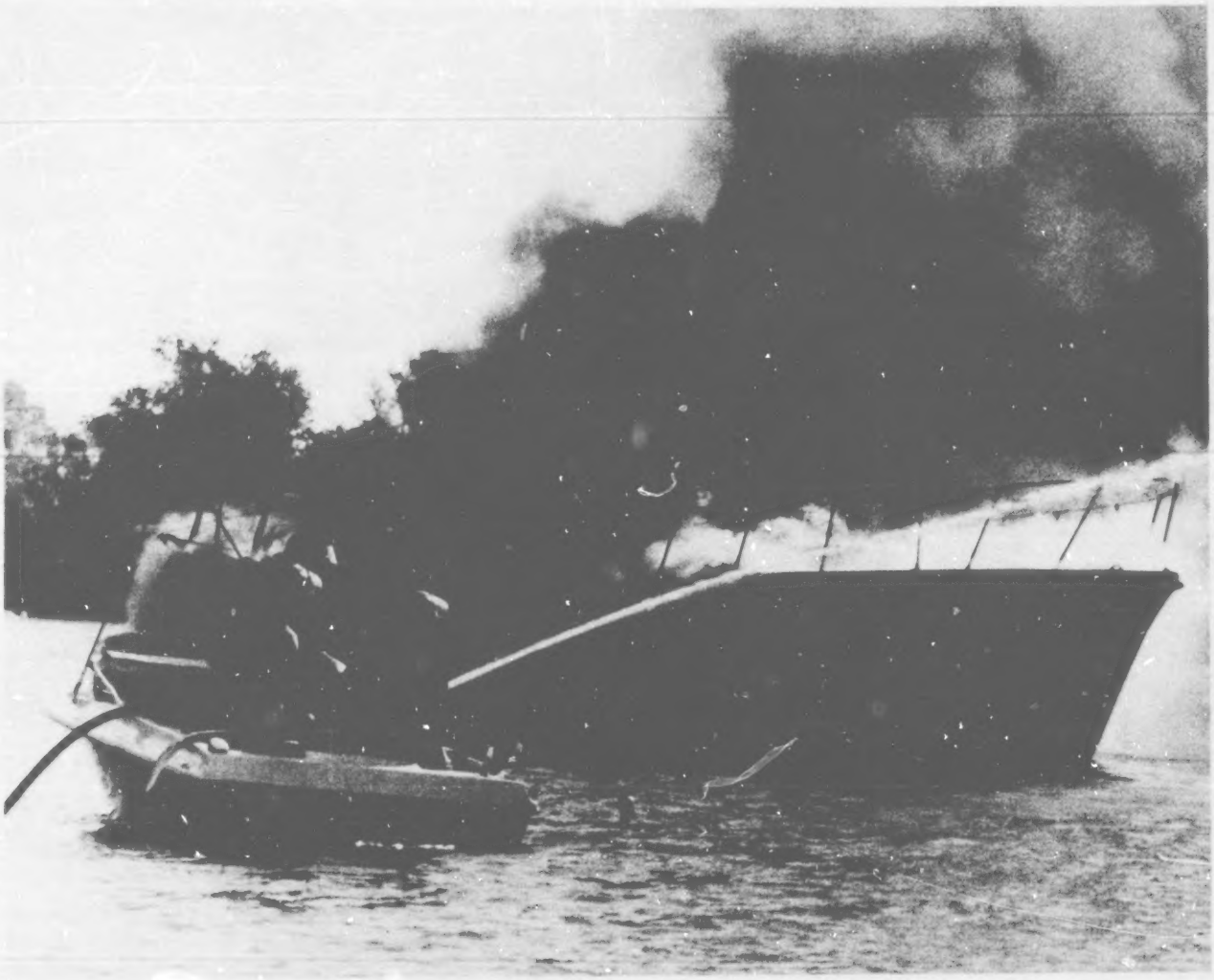
If the fire gets out of hand or an explosion occurs, there is not much you can do except get into the water with your PFD and swim clear of danger. If you have time, display a distress signal or transmit a "Mayday" call on your radiotelephone.

Falls Overboard

The procedure for retrieving a person who has fallen overboard is as follows:

1. If the person overboard is not wearing a life jacket, throw him or her a PFD.
2. Keep the person in sight, and return to him or her as soon as possible.

Fig. 6-5. Boat on fire



3. If your craft is a powerboat, keep the stern at a safe distance from the victim.
4. Reduce speed as you approach, and stop the motor before you come up to the victim. If possible, approach from downwind or against the current so that the boat will not drift into or over the person in the water.
5. Talk to the person during the rescue effort to provide reassurance and determine whether he or she has suffered any injury. Be careful when lifting an injured person aboard; you may cause further injury. Get medical help if necessary.
6. If you must go overboard to help the person, wear a life jacket and carry a line attached to the boat.

Collisions and Groundings

The principal cause of a vessel colliding with another or striking a fixed object is failure of the skipper to maintain a proper lookout. Rules of the road have been formulated to help boaters navigate safely on the waterways, but they cannot prevent accidents that are due to inattention. If you are operating a powerboat where there is risk of collision with other boats, remember that a vessel crossing off your starboard bow has the right-of-way; take care to keep clear.

Collisions

If you are involved in a collision that results in injuries or significant damage to the boat, you should if possible head quickly for the nearest calm shore. The longer your damaged boat is exposed to rough water, the greater the chance that it will capsize. Although you may face the risk of causing further damage to the craft, a landing on a sandy or muddy shore will enable you to get passengers and crew to safety and salvage expensive equipment.

Remember also that if you are involved in a boating accident, you are required by law to give assistance to the other persons involved. If any person dies, disappears, or is injured and requires medical attention beyond first aid, or if the total property damage to the boat(s) involved exceeds $200, you must file an accident report. (See the section on accidents in the pamphlet *ABCs of the California Boating Law.*)

Groundings

Running aground may not be serious if the bottom is sandy or muddy. If your boat has run aground, relatively simple measures will usually get it afloat again. (See figs. 6-6 and 6-7.) After making sure that the boat has sustained no damage that would make it unsafe to refloat, try one or more of the following methods to get it free:

1. Shift the weight of the passengers; this will often free a lightly grounded boat.
2. Try pushing the boat free with oars or a boat hook.
3. If the bottom is firm and the water is shallow, the passengers may be able to get out and push the boat free.
4. If your craft is grounded in a tidal area, the rising tide will probably float it free. If you are waiting for the tide to free your boat, drop anchor in the direction of deeper water; this will keep the boat from being washed farther ashore as the water rises.
5. Ask another boater to give you a tow or make a wake that could rock your boat free. In general, it is not a good idea to try to get off a grounding under your own power; you may damage your propeller, and putting the drive in reverse may push more mud under the boat and ground it even more firmly.

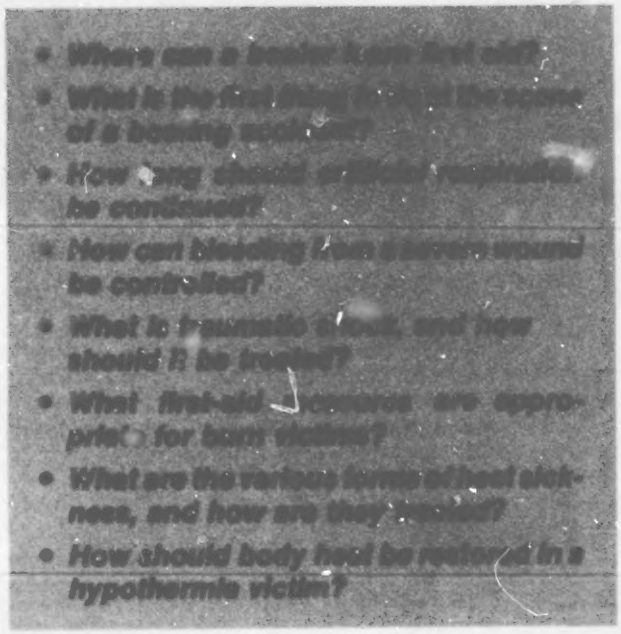
Fig. 6-6. Grounded sailboat

Fig. 6-7. Checking for damage

80

Chapter Seven

First Aid


• Where can a boater learn first aid?
• What is the first step to take at the scene of a boating accident?
• How long should artificial respiration be continued?
• How can bleeding from a severe wound be controlled?
• What is traumatic shock, and how should it be treated?
• What first-aid measures are appropriate for burn victims?
• What are the various forms of heat sickness, and how are they treated?
• How should body heat be restored in a hypothermia victim?

Knowing how to administer first aid in medical emergencies is an asset for anyone, and it is a must for all boaters. Medical assistance may not always be readily available when you are boating far from shore or in a remote area, so you must be prepared to provide emergency care for yourself and others in the event of an accident or sudden illness. Immediate action is necessary if the emergency is life threatening, as when an accident victim stops breathing or is rapidly losing blood from a severed artery. However, acting in great haste and in the wrong way may be worse than doing nothing at all. For example, lifting or dragging a person who has a broken neck or back may sever nerves and result in paralysis or death.

Some basic first-aid procedures of importance to boaters are described in this chapter. You should supplement this information with additional reading in more detailed first-aid books and pamphlets, and you should practice the described techniques with a friend so that you will be ready to use them in real emergencies. (For other publications that contain first-aid information, see the Selected References section in the back of this book.)

An even better way to learn more about first aid and get "hands-on" experience in the techniques of emergency care is to enroll in a first aid course. Training in standard first-aid procedures, including cardiopulmonary resuscitation (CPR), is available in classes conducted by local chapters of the American Red Cross and by other agencies that promote water safety.

First Aid for Accident Victims

The first few minutes—even seconds—may be critical when you arrive at the scene of an accident. If you are the first one there and it is evident that your help is urgently needed, quickly assess the situation and take whatever steps are necessary to save lives or prevent injuries from becoming worse. Take charge until someone arrives who is better qualified to provide

emergency medical care. Act quickly and decisively, but remain calm. Your calmness will reassure the accident victims and make them more cooperative, and it will enable you to think more clearly in making the necessary decisions.

The first thing to do at the scene of a boating accident is make a quick check for hazards that could threaten the lives of victims or rescuers, such as fire, spilled gasoline, imminent swamping due to a bad leak in the hull, or (if the accident site is at dockside) exposed electrical wires that may be carrying shore-based power. Do whatever is necessary to eliminate or reduce the hazard; then begin immediately to administer first aid to those who need it. If there is more than one victim or if the victim has sustained multiple injuries, you will have to establish priorities for your first-aid efforts. Give immediate attention to anyone who is not breathing; death can occur within four to six minutes if breathing stops, and brain damage may result in half that time. Open the victim's airway and start "rescue breathing" (give artificial respiration). Next in priority—and almost as urgent—is stopping heavy bleeding from a severe wound. Pressure applied directly over the wound will usually stop the flow. If there are other injuries, treat them in the order of their severity, using the procedures described in this chapter and in standard first-aid textbooks. Always be watchful for signs of shock; it can kill even though the injuries that cause it may not in themselves be fatal.

As soon as possible, get medical assistance for persons who are injured or sick. If there are others present who could go for help, have someone do so. In any case, do not leave a victim to get help until his or her normal breathing has been restored, severe bleeding has been stopped, and other injuries have been attended to. Get medical help even if you think the injury or illness may not be serious. The only evidence of a life-threatening internal injury may be the paleness and weakness that accompany traumatic shock, and by the time shock sets in, precious minutes needed for emergency care may have been lost.

Unless imminent danger compels you to do so, do not move an accident victim who may have broken bones or internal injuries. If you must move a person who has suffered a fracture, use whatever means are at hand to splint or otherwise immobilize the break. A splint can be improvised from a sail batten, a broken paddle, or even a piece of trim ripped from the boat.

Artificial Respiration

Artificial respiration must be started immediately if an injured or sick person stops breathing or is having great trouble breathing. The method most often used is mouth-to-mouth (or mouth-to-nose) resuscitation. It is simple and effective, and since it does not require special equipment it can be started immediately after rescue, even in the water if necessary. (You should never waste time trying to pump water out of a nearly drowned person's lungs; get air into them instead.)

First make sure that artificial respiration is needed. Look, listen, and feel. Look for rising and falling of the victim's chest. Listen close to the victim's mouth for sounds of breathing. If you hear none, feel for movement of air on your cheek. If no breathing is evident after 5 seconds, administer mouth-to-mouth resuscitation as follows:

1. Open the victim's airway by tilting his or her head back until the chin is pointing upward. (See Fig. 7-1.) Opening the airway in this manner is often enough to restore breathing. If it does not, proceed to step 2.
2. With the victim's head tilted back, pinch his or her nostrils shut. Then place your mouth tightly over the victim's and deliver four quick, full breaths, allowing air to escape after each breath. (See Fig. 7-2.)
3. Again check for breathing (look, listen, and feel). If natural breathing has not been restored, proceed to step 4.
4. If the victim is an adult, continue to deliver full breaths at the rate of about 12 per minute (one every 5 seconds). For a child, give relatively shallow breaths about 20 times per minute. If the victim is an infant, give shallow *puffs* of air about 20 times per minute, placing your mouth over the infant's mouth and nose.
5. Continue the process without interruption until the victim is breathing normally or until help comes.
6. If you cannot easily get air into the victim's lungs, there is probably an obstruction in the airway. Quickly roll the victim onto his or her side and try to dislodge the obstruction by delivering several sharp, rapid blows between the shoulder blades with the heel of your hand. (See Fig. 7-3.) Then clear the mouth, roll the victim onto his or her back, and try again to administer artificial respiration. When attempting to clear a blocked airway in an infant or a small child, suspend the victim head downward and adminster a few sharp pats between the shoulder blades. (See Fig. 7-4.)
7. Do not become discouraged and give up too soon. In most cases where artificial respiration is successful, the victim begins to breath normally within a few minutes. The process may take much longer, however, especially when the stoppage of breathing is caused by electric shock, gas poisoning, or drug overdose. Victims of electric shock have been known to recover after eight hours of artificial respiration.
8. Keep the victim lying down and warm (but not overheated) during and after artificial respiration.

Fig. 7-1. Tilting the head back

Fig. 7-2. Inflating the lungs

Fig. 7-3. Dislodging a blockage

Control of Severe Bleeding

Blood that is spurting or gushing from a wound must be controlled immediately. If the loss of blood is allowed to continue, death may result within a few minutes. To control the bleeding, apply hand pressure directly over the wound. A small wound may require only finger pressure. (See Fig. 7-5.) It is also helpful to elevate the affected part so that it is higher than the heart, but do not do this if there are fractures or if r g the part causes additional pain or injury. If gauze or cloth is immediately available, fold up a thick pad and place it over the wound before you apply pressure. Preferably the material used should be sterile or at least clean, but any cloth will do in an emergency. Loss of blood is more dangerous at this time than risk of infection. Do not remove the dressing if it becomes blood soaked; just add more layers of gauze or cloth and continue applying pressure. Conscious victims may be able to apply pressure to their own wounds.

If bleeding stops or you must attend to other injuries, make a presssure dressing by wrapping the pad with a gauze or cloth bandage. (See Fig. 7-6.) Sometimes a pressure dressing alone is enough to control the bleeding in a wound, without the need for hand pressure.

If pressure applied directly over the wound does not stop the bleeding, you may be able to control it by also applying pressure to the artery that is supplying blood to the wound (the "pressure-point" system). For wounds in the arm or hand, the pressure point is on the inner part of the arm, midway between the armpit and the elbow. (See Fig. 7-7.) By applying finger pressure there, you will compress the brachial artery and restrict blood flow to wounds that are below the pressure point; but you must also continue to apply direct pressure over the wound and if possible keep the affected part elevated. If the bleeding is from a wound in the leg or foot, apply pressure to the femoral artery while also maintaining direct pressure on the wound and if possible keep it elevated. The pressure point for each femoral artery is in the crease of the groin area, over the pelvic bone. (See Fig. 7-8.)

(Note: The ability to locate the appropriate pressure points quickly and apply pressure in the right way is a skill that is best learned in a first-aid class with demonstrations by a competent instructor.)

Use of the tourniquet. A tourniquet is a tight band applied around an arm or leg to stop loss of blood from a wound. It is a dangerous device that should be used only for severe, life-threatening bleeding that can-

Fig. 7-4. Dislodging a blockage (child)

Fig. 7-5. Applying pressure

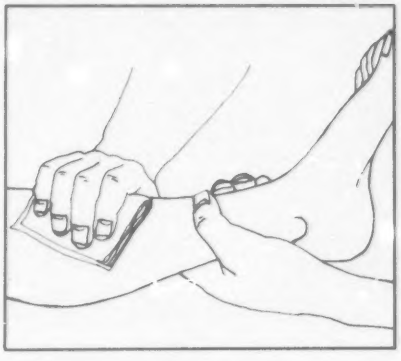


Fig. 7-6. Pressure dressing

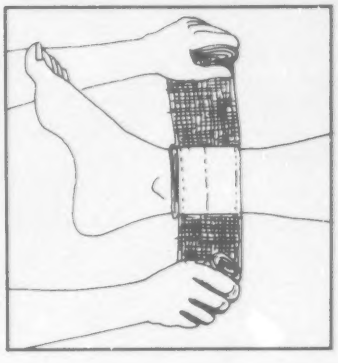


Fig. 7-7. Upper-arm pressure point

not be controlled by any other means. The constriction shuts off blood flow not only to the wound but also to all other points beyond the tourniquet, and if the tissues are deprived of blood for too long they may die. The tourniquet should only be tight enough to stop the bleeding.

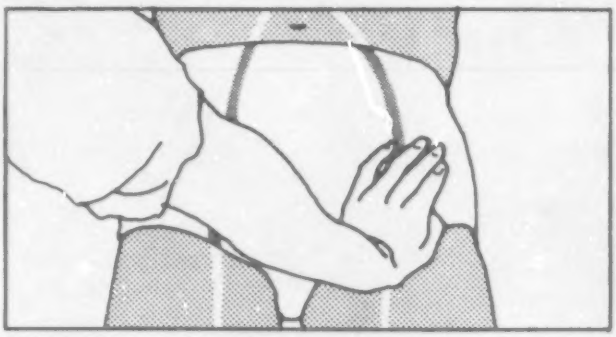
An accident victim whose bleeding has been stopped by means of a tourniquet needs prompt medical attention. The tourniquet must not be allowed to remain on too long, but once it has been placed it should be loosened only by a medical doctor.

Shock

Injury-related shock, commonly called traumatic shock, is different from electric shock, insulin shock, and other special forms of shock. It is a condition in which blood circulation is restricted and as a result vital body functions are impaired. Traumatic shock in some degree acompanies every serious injury, and if it is severe enough it can threaten life. Some common symptoms of traumatic shock are general weakness, a pale or ashen-gray face and cold, clammy skin, shallow and irregular breathing, and a rapid but weak pulse. First aid for traumatic shock should be given to every seriously injured person, whether or not the victim displays symptoms of shock:

1. Make the victim comfortable. In general, the best position for a person experiencing traumatic shock or in danger of going into shock is lying on the back with the feet slightly elevated. (See Fig. 7-9.) However, the nature of the victim's injury must be considered. If the victim has head or chest injuries or is having difficulty breathing, the head and shoulders should be raised slightly—not the feet. An unconscious person should be kept lying flat or with the head slightly elevated.
2. Maintain the victim's normal body temperature. If the weather is cold or damp or the victim has been in cold water, wrap the victim with a blanket or extra clothing if you can do so without inflicting further pain or injury. Otherwise, simply cover the victim with the blanket or clothing and tuck in the covering if possible. If the environment is hot and sunny, shade the victim and do not add heat.
3. Get medical help for the victim as soon as possible. Do not give the victim food or alcoholic drinks. Do not give fluids if the victim is unconscious, having convulsions, vomiting, or becoming nauseated, or if he or she is likely to require surgery.

Fig. 7-8. Groin area right-side pressure point



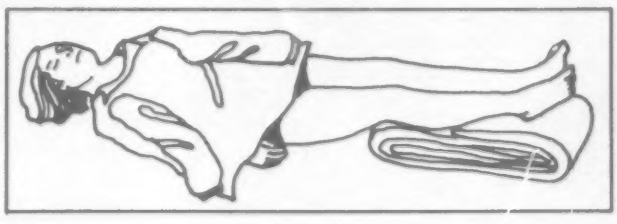
Burns

Burns are usually classified as first, second, or third degree according to the severity of the injury. First-degree burns are characterized by reddened but not blistered skin, mild swelling, and relatively mild pain. Second-degree burns are more serious; they involve the inner as well as the outer layers of skin, cause red blisters to form, and are extremely painful. Third-degree burns inflict the deepest damage, destroying all the skin layers and often charring the burned area. Because the nerve endings are destroyed, a third-degree burn may not be as painful as a second-degree burn.

The size of a burn is also a factor in determining its seriousness. For example, an extensive sunburn—even if no deeper than first degree—can be serious enough to require a doctor's attention.

Treatment of first-degree burns. First aid for first-degree burns consists of applying cold water and/or a dry, sterile dressing to the burned area. Covering a burn excludes air and relieves pain. Never put butter or margarine on any burn, and never use patent o:

Fig. 7-9. Treating for shock



home medications on other than minor first-degree burns.

Treatment of second-degree burns. Bathe second-degree burns in cold water. Do not break blisters. Blot the burn dry with a sterile cloth, and cover it with a dry, sterile cloth for protection and relief of pain. Watch for symptoms of shock, and treat at the first sign. If the burn is extensive or is causing considerable pain, treat for shock as a precautionary measure even if there are no shock symptoms. Get medical assistance.

Treatment of third-degree burns. Protect third-degree burns with a sterile cloth. Do not apply ice water. Treat the victim for shock; it is a major threat in severe burn cases. For conscious victims, fluid replacement is advisable to help prevent shock if medical attention will be delayed for an hour or more. (Do not give alcohol.) Watch for difficulty in breathing. Do not attempt to remove charred clothing that sticks to the burn; just protect the wound and get medical help as soon as possible.

Treatment of chemical burns. Burns to the skin and eyes caused by acids and other harmful chemicals are similar to those caused by fire, steam, or hot liquids. First aid consists of flushing the burned area with water for at least five minutes and removing any affected clothing. If an eye is affected, flush it for at least 15 minutes; then cover it with a sterile pad. Get medical help.

First Aid for Heat Sickness

A person who is exposed to extreme heat for too long may suffer heat exhaustion, heat cramps, or heatstroke. The danger is increased if the overexposure is coupled with overexertion.

Heat Exhaustion

The predominant symptom of heat exhaustion is faintness, usually accompanied by profuse sweating and a pounding pulse. The skin is pale and clammy, and the victim may experience headache and nausea. Body temperature is approximately normal. First aid for heat exhaustion consists of getting the victim to lie down and rest in a cool place, then administering three or four doses of a salt solution (one-half teaspoon of salt in one-half glass of water), waiting about 15 minutes between doses. Heat exhaustion is not life threatening, but severe cases should receive medical attention.

Heat Cramps

Heat cramps are painful contractions of abdominal, leg, or arm muscles brought about by depletion of salt from the body fluids as a result of excessive sweating. The victim may be doubled up in excruciating pain. To relieve the cramping, give the saline solution described above for heat exhaustion, and repeatedly apply firm pressure to the affected muscles. Do not apply hot packs; they will make the cramps worse.

Heatstroke (Sunstroke)

Heatstroke is a serious, often fatal illness caused by failure of the body's sweating mechanism. It requires immediate first aid and subsequent medical care. Symptoms include very high body temperature (105 to 109° F. [40.6 to 42.8° C.]); headache; weakness, often with dizziness and nausea; rapid, pounding pulse; and very hot, dry, and reddened skin. The onset of the illness may be very rapid, and the victim may suddenly lose consciousness.

The first thing to do in treating heatstroke is bring down the body temperature. Move the victim to a shady or cool place. If possible, immerse the victim in cool water. Otherwise, remove the victim's clothing and have him or her lie down with the head and shoulders slightly elevated; then flood or sponge the victim's body with cool water. Give special attention to the upper body and head, since much heat will be concentrated there. Rub the victim's arms and legs toward the heart to promote circulation. If the victim is conscious, administer the salt solution described earlier for heat exhaustion and heat cramps. Give cold (not iced) drinks but no stimulants. Get medical help for the victim as quickly as possible.

First Aid for Hypothermia

Since hypothermia victims are losing heat faster than their bodies can produce it, they must be brought back to normal temperature by external means. To treat a person who has been rescued from cold water, proceed as follows:

1. Make sure the victim has an open airway and is able to breathe. Administer artificial respiration if necessary.
2. Quickly but gently move the victim to a sheltered and warm area. Do not let him or her walk, as this will encourage the flow of cold, stagnant blood from the limbs to the heart. If this cold blood returns to the core of the body, it may reduce the core temperature to a level that is too low to sustain life.
3. Gently remove all wet clothing; cut it away if necessary. Dry the victim thoroughly.
4. Apply warmth to the victim's trunk. An effective field treatment is for one or more of the rescuers to remove their clothing and warm the victim with their bodies. Blankets or sleeping bags wrapped around the group will conserve warmth.

   If a warm bath or shower is available, warm the victim in 105 to 110° F. (40.6 to 43.3° C.) water (but do not place an unconscious victim in a bathtub). After the bath or shower, dry the victim thoroughly and keep him or her warm. Hot water bottles or heated blankets may also be used to warm the victim.
5. As for any serious injury or illness, get medical help for the victim as soon as possible.

Glossary

Aboard: On board; on or within a boat.
Afloat: On the water.
Aft: On or toward the stern or rear part of a boat; opposite of *forward.*
Aground: Not having enough water to float; boat in contact with the bottom.
Ahead: In a forward direction; in front of the boat; opposite of *astern.*
Alee: On or toward the lee side (the side away from the wind); opposite of *to weather.*
Anchor: A heavy object or device used to hold a boat to the bottom by means of connecting line; to secure by means of an anchor. (See *Ground tackle, Rode.*)
Astern: In a backward direction; behind the boat; opposite of *ahead.*
Bailer: A bucket or other container used to remove water from a boat.
Ballast: Weight used to give a boat proper stability and trim.
Battens: Thin, flexible strips of wood or plastic inserted in pockets in a sail to stiffen the leech (the after edge of the sail).
Beam: The breadth of a boat at the widest part of the hull.
Bearing: Direction by compass; also, direction relative to the fore-and-aft centerline of the boat.
Bend: A knot used to join two lines; to make a knot or fasten a line.
Bight: A loop of line; a bend in a river.
Bilge: The lowest spaces within the hull of a boat.
Bitter end: The free end of a length of line; the end that is made fast when the line has been paid out.
Boat: Any small watercraft, usually under 65 feet in length. (See *Ship.*)
Boom: A spar that secures and extends the foot of a sail.
Bow: The forward part or front of a boat.
Broach: To swing broadside to the waves, with danger of swamping or capsizing, when running downwind or in a following sea.
Buoy: A floating, anchored marker used as a navigational aid or to mark a danger spot.
Buoyant: Having the ability to float.
Capacity plate: An information plate in a boat that indicates the maximum weight and number of passengers the boat should carry under normal conditions.
Capsize: To turn over.
Cast off: To detach and release a line, as from a cleat.
Caulking: Cotton, oakum, or synthetic filler material forced into the seams of a boat to prevent leaking.
Centerboard: An adjustable keel, usually consisting of a thin slab of wood, metal, or fiberglass, that pivots at the forward end.
Centerboard trunk: The housing for the centerboard.
Chafe: To weaken or damage by rubbing.
Channel: The deeper, navigable part of a body of water; often marked by buoys.
Chart: A map of a water area showing water depths, shore contours, channels, navigational aids, hazards, and other information of concern to mariners.
Chine: The intersection of the side and bottom of a flat-bottomed or V-bottomed boat.
Cleat: A fitting to which a line is secured.
Clew: The rear lower corner of a sail.
Close-hauled: Sailing as near to the wind as possible.
Cockpit: An open well in the deck, from which the crew operates the boat.
Come about: To change from one tack to the other, with the bow crossing the wind.
Compass: An instrument for determining directions relative to magnetic north.
Course: The route a vessel is following to reach its destination; also, the compass point toward which the vessel is being steered.
Current: A horizontal movement of water (for example, a tidal current).
Daggerboard: A centerboard that slides vertically in the trunk instead of turning on a pivot.
Deck: The covered part of the top of a boat.
Deviation: Error in a compass reading caused by nearby iron, steel, or other magnetic material or by stray magnetic fields from electrical equipment or wires.
Dinghy: A small boat used as a tender for a larger boat.
Dock: The slip or waterway in which a vessel is stationed when moored to a pier or wharf; in popular usage, the pier or wharf itself.
Downhaul: A line used to pull down the luff (forward edge) of a sail.
Drift: The distance a boat is pushed off course by the current.

Ease off: To slowly let out or release a taut line.

Ebb: The horizontal outflow of tidal water to the sea. (See *Flood.*)

Eye: A closed loop in a line, formed by means of a splice or a knot; the open center of a ring.

Fenders: Cushioning devices hung over the side of a boat to protect the hull from impact or abrasion.

Fend off: To hold off when making a landing or coming alongside.

Flat water: Lakes, quiet rivers, and other water bodies which lack the steep gradients and and turbulent currents that are characteristic of wild rivers and mountain streams. (See *White water.*)

Float plan: A brief document, left with a reliable person ashore prior to a cruise, that identifies the vessel and lists its planned destination, departure and return times, persons aboard, and other information that would aid a search and rescue effort.

Flood: The horizontal inflow of tidal water from the sea. (See *Ebb.*)

Foot: The bottom edge of a sail.

Forward: On or toward the bow or front part of a boat; opposite of *aft.*

Freeboard: The vertical distance from the gunwale of a boat to the waterline, measured amidships.

Give-way vessel: The vessel which must stay clear of another having the right-of-way. (See *Stand-on* vessel.)

Gooseneck: A fitting used to attach a boom to a mast.

Ground tackle: Anchors, lines, chains, and associated gear used for anchoring.

Gunwale: The upper edge of the side of a boat.

Halyard: A line used to raise and lower a sail, flag, or signal.

Heading: The direction in which the bow of a boat is pointed.

Head up: To change course to windward.

Heave: To throw, as a line.

Heel: The leaning of a boat.

Hike out: To lean out as far as possible on the windward side of a sailboat to prevent excessive heeling.

Hiking strap: A strap attached to the floorboards or centerboard trunk of a sailboat under which a crew member can hook a foot when hiking out.

Hypothermia: Subnormal body temperature that results when the body loses heat faster than it can produce it.

Inboard: Within the hull.

Jib: A small, triangular sail carried forward of the mast.

Jibe: To change from one tack to the other when sailing before the wind, without coming about. (See *Come about.*)

Keel: The major fore-and-aft structural member in a hull; also, a fin-like downward extension of a sailboat's hull, often containing ballast, that increases the lateral stability of the boat.

Knot: A tie made in a line; a bend or hitch; also, a unit of speed measurement equal to one nautical mile per hour. (See *Nautical mile.*)

Lee: The side away from the wind.

Leech: The after edge of a fore-and-aft sail.

Lee shore: The shore lying off a vessel's leeward side.

Leeward: On or toward the side away from the wind; opposite of *windward.*

Leeway: Leeward movement of a vessel due to wind.

Life jacket: A buoyant jacket or vest worn for protection in the event of a fall overboard. (See *Personal flotation device.*)

Line: Rope that is used aboard a boat.

Log: A written record of a vessel's voyage.

Loran (LOng RAnge Navigation): An electronic aid to navigation that provides position information by means of radio pulses transmitted from pairs of shore stations.

Lubber line: A reference line on a compass bowl that is parallel with the fore-and-aft centerline of the boat.

Luff: The forward edge of a sail.

Mainsail: The principal sail on the mainmast.

Make fast: To secure or tie to, as a line to a cleat.

Mast: An upright spar that supports sails and associated rigging.

Mooring: A permanent or semipermanent place for tying up a boat, as at a pier, a wharf, or a mooring buoy.

Mooring buoy: A buoy to which a boat may be tied instead of being secured with its own anchor.

Nautical mile: 6,076 feet (1,852 metres); approximately 1⅛ statute miles.

On a port tack: Sailing with the wind coming from the port side.

On a starboard tack: Sailing with the wind coming from the starboard side.

Outboard: Away from the center or toward the outside of the boat.

Pay out: To ease or let out a line, as from around a piling.

Personal flotation device (PFD): A wearable or throwable device used for keeping a person in the water afloat; required on all boats. (See "Personal Flotation Devices" in the booklet *ABCs of the California Boating Law.*)

Pointing: Sailing close to the wind.

Points of sail: The various headings a boat can take relative to the wind.

Port: The left side of a boat, as seen from aboard facing the bow.

Reaching: Sailing with the wind coming from the side.

Reefing: Reducing the area of a sail by rolling or tying part of the sail to the boom.

Rigging: The general term for all the shrouds, stays, sheets, and other lines and associated fittings on a boat.

Rode: The anchor line, chain, and fittings used to connect an anchor to a boat.

Roll: The sideward rocking motion of a boat.

Rudder: A vertical plate, mounted on hinges or a rudder post at the stern, that can be turned right or left on its vertical axis to steer the boat.

Running: Sailing before the wind (with the wind coming over the stern).

Rules of the road: Governmental regulations for preventing collisions on the water. (See "Inland Rules of the Road" in the booklet *ABCs of the California Boating Law.*)

Sailboat: A boat propelled by wind and sails; may also have an auxiliary engine.

Scope: The relationship between the length of the rode (anchor line and chain) and the vertical distance from the bow to the bottom, expressed as a ratio; should be at least 5 to 1.

Sea anchor: A canvas cone or similar device attached to a

line and thrown off the bow to keep a boat pointed into the wind or sea; also called a drogue.

Shear pin: A replaceable, soft-metal pin that connects the propeller to the drive shaft and breaks if the propeller strikes a hard object.

Sheet: A line used to control the direction of a sail.

Ship: A large watercraft, usually over 65 feet (19.8 metres) in length. (See *Boat.*)

Shrouds: Lines or wires that extend from the mast to the sides of a boat to give the mast lateral support.

Skulling: A technique for propelling a small boat by means of a single oar used at the stern.

Spar: The general term for any mast, boom, or other pole on a watercraft.

Squall: A brief rain-and-wind storm that arrives and departs suddenly.

Stand-on vessel: The vessel with the right-of-way. (See *Give-way vessel.*)

Starboard: The right side of a boat, as seen from aboard facing the bow.

Stays: Lines or wires that extend fore and aft from the mast to brace it longitudinally.

Stern: The after end or back of a boat.

Stream a line: To drag a line off the transom to slow the boat or to establish a straight line upon which to sight in a heavy fog.

Tack: To sail a zigzag course in the direction from which the wind is blowing.

Take in: To pull in and secure, as when removing slack from a line.

Thwart: A seat or structural member extending from side to side in a boat.

Tide: The rise and fall of waters caused by the gravitational attraction of the moon and sun.

To weather: On or toward the windward side; opposite of *alee.*

Transom: The transverse board or planking that forms the stern of a square-ended boat; may have a cutout or recess for an outboard motor.

Trim: The attitude of a boat in the water relative to its designed waterline.

Under way: Not moored, anchored, or aground.

Variation: Error in a compass reading due to angular differences between geographic north and magnetic north.

Wake: The track and waves left behind by a moving boat.

Waterline: A line on a boat's hull that is parallel with the surface of the water when the boat is properly trimmed.

White water: Foamy, aerated water, usually found in mountain streams where the water rushes over and around rocks.

Windward: On or toward the side from which the wind is coming; opposite of *leeward.*

Publications Available from the Department of Education

This publication is one of approximately 500 that are available from the California State Department of Education. Some of the most-requested titles and those of particular interest to the users of this document are the following:

California Public School Directory	$12.50
Boating the Right Way (1985)	4.00
Boating the Right Way audiovisual package (3 filmstrips and 3 cassettes)	30.00
Handbook for Planning an Effective Mathematics Program (1982)	2.00
Handbook for Planning an Effective Reading Program (1983)	1.50
Handbook for Planning an Effective Writing Program (1983)	2.50
Health Instruction Framework for California Public Schools (1978)	1.35
Manual of First-Aid Practices for School Bus Drivers (1983)	1.75
Physical Conditioning Through Water Exercises (1972)	1.00
Physical Performance Test for California, 1982 Edition (1984)	1.50
Raising Expectations: Model Graduation Requirements (1983)	2.75
Science Education for the 1980s (1982)	2.00
State Guidelines for Schools Athletic Programs (1978)	2.20
Wet 'n' Safe: Water and Boating Safety, Grades 4—6 (1984)	2.50

Orders should be directed to:

California State Department of Education
P.O. Box 271
Sacramento,CA 95802-0271

Remittance or purchase order must accompany order. Purchase orders without checks are accepted only from government agencies in California. Sales tax should be added to all orders from California purchasers.

A complete list of publications available from the Department, including apprenticeship instructional materials, may be obtained by writing to the address listed above.

A list of approximately 100 diskettes and accompanying manuals, available to member districts of the California Computing Consortium, may also be obtained by writing to the same address.

Selected References

ABCs of the California Boating Law. Sacramento: Department of Boating and Waterways, California Resources Agency, current edition.

Basic Outboard Boating. Washington, D.C.: American National Red Cross, 1971.

Basic Rowing. Washington, D.C.: American National Red Cross, 1964.

Basic Sailing. Washington, D.C.: American National Red Cross, 1970.

Bavier, Robert N., Jr. *Sailing to Win*. New York: Dodd, Mead and Company, 1983.

Beebe, Robert P. *Voyaging Under Power*. New York: Seven Seas Press, 1975.

Boating Skills and Seamanship (Eighth edition). Newark, Del.: United States Coast Guard Auxiliary, 1979.

Boating Statistics. Washington, D.C.: Department of Transportation, United States Coast Guard, current edition.

California Boating Safety Course. Seattle: Outdoor Empire Publishing, Inc., 1980. (Available from the California Department of Boating and Waterways, 1029 S Street, Sacramento, CA 95814.)

Canoeing and Kayaking. Washington, D.C.: American National Red Cross, 1981.

Chapman, Charles F., and E. S. Maloney. *Piloting, Seamanship and Small Boat Handling* (Fifty-sixth revised edition). New York: Hearst Books, 1983.

Drugs and Their Abuse. Washington, D.C.: American National Red Cross, 1971 (pamphlet).

First Aid. Charlotte, N.C.: Boy Scouts of America, 1981.

Grant, Sea. *First Aid for Boaters and Divers*. Piscataway, N.J.: New Century Publications, 1980.

Lane, Carl D. *Boatman's Manual* (Fourth edition). New York: W. W. Norton & Co., 1979.

Lifesaving and Marine Safety. Prepared by the U.S. Lifesaving Association. Piscataway, N.J.: New Century Publications, 1981.

Lifesaving, Rescue, and Water Safety. Washington, D.C.: American National Red Cross, 1982.

McNair, Robert E. *Basic River Canoeing* (Third edition). Martinsville, Ind.: American Camping Association, 1972.

Melges, Buddy, and Charles Mason. *Sailing Smart: Winning Techniques, Tactics and Strategies*. New York: Holt, Rinehart and Winston, 1983.

Navigation Rules: International—Inland. Washington, D.C.: U.S. Department of Transportation, United States Coast Guard, 1982.

Royce, Patrick M. *Royce's Sailing Illustrated* (Sixth edition). Ventura, Calif.: Western Marine Enterprises, 1974.

Royce, Patrick M. *Royce's Trailer-Boating Illustrated* (Revised edition). Ventura, Calif.: Western Marine Enterprises, 1981.

Standard First Aid and Personal Safety (Second edition). Prepared by American National Red Cross. Garden City, N.Y.: Doubleday & Co., Inc., 1979.

Tillman, Dick. *Laser Sailing for Beginners and Experts*. New York: Yachting Publishing Corporation, 1975.

The Time-Life Library of Boating (12 vols.). Chicago: Time-Life Books, 1975-76. Available titles are as follows:

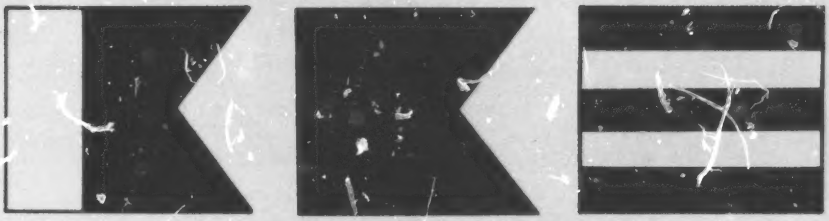
The Boat (1975)
Boat Handling (1975)
The Classic Boat (1975)
Cruising (1975)
Cruising Grounds (1975)
The Handy Boatman (1976)
Maintenance (1976)
Navigation (1976)
Offshore (1976)
Racing (1976)
Seamanship (1975)
Sports Afloat (1976)

Wetmore, Reagh C. *Drownproofing Techniques for Floating, Swimming and Open Water Survival*. Brattleboro, Vt.: Stephen Greene Press, 1981.

Boating the Right Way supplemental audiovisual package. Sacramento: Department of Boating and Waterways, California Resources Agency, 1983. (Distributed by Publications Sales, California State Department of Education, P.O. Box 271, Sacramento, CA 95802-0271.) Consists of three 35 mm. color filmstrips and accompanying audio cassettes, with the following titles and running times:

Good Seamanship—A Preface to Fun (10:30)
A Margin of Safety—Rules of the Road (15:15)
Live and Learn—Water Oriented First Aid (10:50)

82-113 03-0090 & 03-0331 300 12-84 5M



ABCs

of the California Boating Law

99

CALIFORNIA DEPARTMENT OF BOATING & WATERWAYS

GEORGE DEUKMEJIAN
Governor of California

GORDON K. VAN VLECK
Secretary for Resources

WILLIAM H. IVERS
Director, Boating and Waterways

To the California Boater:

California's waterways entice millions of boaters every year who are seeking an enjoyable outdoor recreational experience. To provide safety and pleasure for all who use our waterways, it is important to know and abide by the few regulations found in this booklet. Equally important is the use of common sense and courtesy afloat. Your individual efforts in boating safety will enhance the enjoyment of those who share the waters with you.

William H. Ivers
Director, Boating and Waterways

The material contained in this pamphlet is based upon the California Harbors and Navigation Code, the Vehicle Code and the Administrative Code, but it does not adhere to the legal text and does not include all the provisions of the law pertaining to boating. Therefore, it is not suitable for use in law enforcement nor in litigation of any nature.

March 1983 (Revised)

TABLE OF CONTENTS

Introduction 4
Registration 4
Required Equipment, General 6
- Personal Flotation Devices 6
- Fire Extinguishers 7
- Engine Noise 8
- Ventilation 8
- Backfire Flame Control Devices 9
- Horns and Whistles 9
- Bells 9
- Running Lights 10
- Anchor Lights 11
- Marine Sanitation Devices 11
- Visual Distress Signals 11

Signals to Attract Attention 12
Reckless or Negligent Operation 12
Recognized Distress Signals 13
Speed 14
Boating and Alcohol 14
Accidents 14
Boating Accident Report Form 15, 16, 17, 18
Inland Navigation Rules Act 19
Inland Rules of the Road 20
- Responsibility 20
- Navigation Signals 20
- Meeting or Crossing 20
- Overtaking 21
- Other 22
- Rules for Sailing Vessels 22
- Fog Signals 22

Law Enforcement 23
Stolen Vessels 23
County and City Laws 23
Water Skiing 24
Weather Advisories 24
Aids to Navigation 25
- Lateral System (Federal) 25
- Uniform State Waterway Marking System 25
- Aids to Navigation Changes 25
- Federal Channel Marking System 26

Recommended Additional Equipment 27
Radio Procedures 28
Float Plan 29
Glossary 31
California Waterway Marker System ..... (Back Cover)

INTRODUCTION

California offers a variety of boating environments to suit almost everyone. Each of these environments places different demands on the boater. The California Boating Law, passed by the state legislature and approved by the governor in 1959, applies to the operation of vessels on all waters within the territorial limits, including coastal waters. The laws and regulations prescribed herein are minimum requirements and should be used as a basis for equipping and operating your boat in a safe manner.

Recommended equipment and safety practices are included. This will allow boaters to equip their craft to meet their boating needs.

In addition to the required equipment, the California Boating Law requires the registration and numbering of all vessels, with few exceptions. It regulates certain boat operations, incorporates "Rules of the Road," prohibits certain dangerous practices and provides for the reporting of accidents and for enforcement.

The California Boating Law, in general, does not replace the United States Coast Guard and other federal regulations in force on federally navigable waters, but is in conformity with these laws.

REGISTRATION

The law requires current registration of certain vessels on waters of the state. This includes vessels that are moored, whether or not they are used. All vessels must be registered and numbered in accordance with the provisions of the California law except:

1. Boats propelled manually.
2. Boats eight feet or less in length propelled solely by sail.
3. Certain public vessels.
4. Vessels documented by the Coast Guard.
5. Foreign vessels.
6. Ship's lifeboats used solely for lifesaving purposes.
7. Vessels having valid registration in the state of principal use and not remaining in California over 90 days.
8. Sailboards.

How to Register:

Application to register a vessel may be made at any office of the Department of Motor Vehicles (DMV). Upon receipt of the required information and fees, DMV will issue a Certificate of Number, a Certificate of Ownership and a set of registration stickers. The boat registration number is the number (beginning with CF) shown on the certificates.

Your vessel may be subject to Use Tax based on the purchase price if it is acquired out-of-state or from a private party. For additional information regarding Use Tax, contact your local DMV office.

The Certificate of Ownership is your evidence of title to the vessel and, therefore, should be kept in a safe place. Certificates issued will also contain the boat's identifying number (known as the hull identification number), which is that number permanently marked on the transom by the manufacturer or builder, or that number assigned by DMV and marked on the

transom by the owner. The reverse side of the Certificate of Ownership is an application for transfer of ownership.

The Certificate of Number, or temporary Certificate of Number, must be available for inspection on the vessel whenever it is being used on the water. Proper display of the current registration stickers on the vessel next to the CF number is required to permit enforcement officers to determine, without boarding, that the vessel is currently registered.

Registration Fees:

Original Registration	$9.00
Transfer of Ownership	$8.00
Duplicate Registration	$5.00
Renewal of Registration (Annual)	$5.00

A $2.00 penalty is added for late registration or late renewal.

Display of Numbers and Stickers:

Numbers and stickers issued at the time of registration must be affixed on each side of the forward half of the vessel, usually on the bow, in the manner indicated (Figure 1). If placement of a number on a flared bow would result in difficult reading, the number should be placed on some other part of the forward half of the vessel where it can be easily read.

On inflatable boats or vessels so configured that a number will not properly adhere or cannot be clearly seen, the number should be painted on or attached to a backing plate along with the registration sticker. The plate should be securely fastened to the forward half of the vessel. The number must be visible from each side of the vessel. No other numbers, letters or devices may be placed in the vicinity of the state assigned number.

The numerals should be separated from the letters by spaces, the width of the letter *C*. Hyphens may be used in these spaces. Letters and numerals must be at least three inches high, of block character and of a color which will form a good contrast with the color of the hull or backing plate. In determining height and contrast, any border, trim, outlining or shading around the number shall not be considered.

(Figure 1)

Notification Requirements:

The owner is required to notify DMV in writing whenever any of the following takes place:

1. The vessel has been destroyed or abandoned. This notice must be given within 15 days and be accompanied by the Certificate of Number and Certificate of Ownership.
2. The owner's address has been changed. This notice must be given within 15 days.
3. The vessel is sold. This notice must be given within 5 days and must include date of sale and name and address of the new owner.

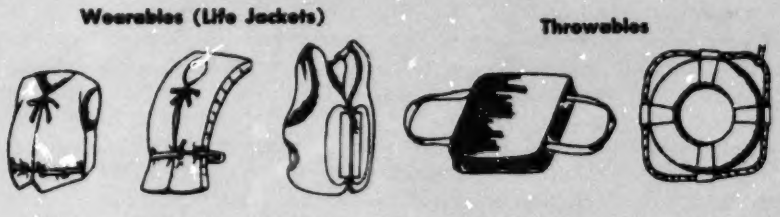
Registration forms may be obtained from any DMV office or from authorized registration agents. The names of authorized registration agents may be obtained by writing the Vessel Registration Unit, Department of Motor Vehicles, Post Office Box 11780, Sacramento, California 95853.

REQUIRED EQUIPMENT, GENERAL

All of the equipment required by the California Boating Law must be kept in serviceable condition. Equipment requirements vary with the size of the vessel and its type of power. Certain features, such as construction or type of engine, will cause equipment requirements to vary.

Motorboats, while participating in approved races and similar activities, are generally exempted from horn, bell, fire extinguisher and muffler requirements. These exemptions are authorized only during races permitted by city, county or federal agencies.

Sailboats with motors of any type are considered to be motorboats for purposes of equipment requirements only . Rowboats or other manually propelled vessels when used with a motor must meet equipment requirements specified for motorboats.


Wearables (Life Jackets)
Throwables
LIFE PRESERVER (Type I)
BUOYANT VEST (Type II)
SPECIAL PURPOSE MARINE BUOYANT DEVICE (Type III)
BUOYANT CUSHION (Type IV)
RING LIFE BUOY (Type IV)

Personal Flotation Devices (PFD's):

All boats, powered or nonpowered, must carry at least one Coast Guard approved personal flotation device for every person aboard. PFD's bearing Coast Guard approval are identified by Types I, II, III or IV. Failure to have a sufficient number of approved devices aboard constitutes a violation of state and federal law. The minimum requirements are:

1. Except canoes and kayaks, all boats 16 feet or over in length: One Type I, II, or III (wearable) for each person on board and one Type IV (throwable) in each boat.

2. Canoes and kayaks of any length and all other boats less than 16 feet in length: One Type I, II, III or IV PFD for each person on board.

PFD's should be stowed in an area allowing easy access in the event of an emergency. The California Boating Law requires that all wearable PFD's must be readily accessible and all throwables must be immediately available.

Such devices must be kept in a serviceable condition. If straps are broken, hardware is missing or the approval number cannot be read, the device is considered to be unserviceable. Having devices that are in an unserviceable condition, also constitutes a violation.

Persons being towed on skis or other contrivances are considered to be "persons on board" and there must be an approved type of device aboard for each skier. The California Boating Law does not require wearing devices while underway. However, common sense will demand wearable PFD's on all children and nonswimmers. All devices must be of suitable size if they are designed to be worn. Adult devices do not satisfy legal requirements for children just as children's devices do not meet flotation requirements for adults.

Nonapproved devices may be carried aboard as excess equipment only. Ski belts are not Coast Guard approved and are not acceptable to meet any legal requirements. Buoyant cushions should never be worn on the back when in use. For further details concerning the types and designs of PFD's, send for the free pamphlet titled "Safe Boating Hints For Personal Flotation Devices" from the Department of Boating and Waterways. (See centerfold postcard).

Fire Extinguishers:

The California Boating Law requires all motorboats to carry fire extinguishers approved for marine use by the Coast Guard. Exemptions are made for outboard pleasure boats less than 26 feet in length without permanently installed fuel tanks and which do not have spaces in which explosive or flammable gases or vapors can collect. The size and number of extinguishers required depends on the size of the boat. The minimum size approved for use aboard pleasure boats is the B–I size.

FOAM EXTINGUISHER

CARBON DIOXIDE EXTINGUISHER

FREON–TYPE EXTINGUISHER

DRY CHEMICAL EXTINGUISHER

Boat length	Without fixed extinguishing system in machinery space	With fixed system in machinery space
Less than 16 ft.	1 B–I	None
16 ft. to under 26 ft.	1 B–I	None
26 ft. to under 40 ft.	2 B–I or 1 B–II	1 B–I
40 ft. to 65 ft.	3 B–I or 1 B–II and 1 B–I	2 B–I or 1 B–II

All extinguishers must be readily accessible (preferably not stowed next to common fire sources), and they must be kept in a serviceable condition.

REMEMBER, the number required by law is only the minimum. Extra extinguishers provide additional safety.

Like flotation devices, not all fire extinguishers available to the public are Coast Guard approved. An extinguisher is approved when, in addition to labels or any other markings, the extinguisher bears the label of a testing laboratory which will include either Coast Guard approval numbers or specify "Marine Type United States Coast Guard" (Figure 2).

(Figure 2)

All carbon tetrachloride extinguishers and others of the TOXIC vaporizing-liquid type, such as chlorobromomethane, are not approved and are not accepted as required fire extinguishers on any motorboats.

For further details concerning the types and designs for approved fire extinguishers, send for the free pamphlet titled "Safe Boating Hints For Fire Extinguishers" from the Department of Boating and Waterways. (See centerfold postcard).

Engine Noise:

Any motorboat operated on the inland waters of this state must be muffled or otherwise prevented from exceeding the following noise levels when recorded at a distance of 50 feet:

- 82 dB(A) for engines manufactured on or after January 1, 1978.
- 84 dB(A) for engines manufactured on or after January 1, 1976 and before January 1, 1978.
- 86 dB(A) for engines manufactured before January 1, 1976.

Authorities generally agree that unbaffled exhaust pipes (stacks) and most water injected pipes do not meet any of the above requirements.

Ventilation:

All motorboats or motor vessels, except open boats, made after 1940 and using gasoline as a fuel shall have at least two ventilator ducts fitted with cowls or their equivalent for the efficient removal of explosive or flammable gases from the bilges of every engine and fuel tank compartment. If engine and fuel tank compartments are closed and separated, two such ventilating systems are required.

There shall be at least one exhaust duct installed so as to extend from the open atmosphere to the lower portion of the bilge and at least one intake duct installed so as to extend to a point at least midway to the bilge or at least below the level of the carburetor air intake. The cowls shall be located and trimmed for maximum effectiveness so as to prevent displaced fumes from being recirculated.

Boats built after July 31, 1980 that have a gasoline engine for electrical generation, mechanical power or propulsion must be equipped with an operable ventilation system. A compartment containing a permanently installed gasoline engine must either be open to the atmosphere or ventilated by an exhaust blower system. The intake duct for an exhaust blower must be in the lower one-third of the compartment and above the normal level of accumulated bilge water. A combination of more than one exhaust blower may be used to meet specified requirements.

Boats equipped with outboard motors or inboard motors not enclosed, and of "open" construction, are exempt from ventilation requirements.

Backfire Flame Control Devices:

Backfire flame control devices are designed to prevent open flame from leaving the carburetion system in the event of a backfire.

Vessels equipped with gasoline engines, except outboard motors, must have a backfire flame control device installed on their engine. These can be either: (a) a Coast Guard approved backfire flame arrestor, suitably secured to the air intake with flame tight connection, (b) approved engine air and fuel induction system, or (c) a flame tight metallic carburetor air intake attachment located or positioned so backfire flames would be dispersed to the atmosphere outside the vessel. This latter device must be acceptable to the Coast Guard and be such that the flames will not endanger the vessel, persons on board or nearby vessels and structures.

Horns and Whistles:

Although the "Rules of the Road" require all vessels to sound proper signals, only motorboats 16 feet and greater in length are *required* to carry horns or whistles. Where required, horns must be in serviceable condition, and if not permanently mounted, they must be readily accessible. The minimum requirements are:

Boat Length	*Requirement*
16 ft. to less than 26 ft.	One hand, mouth, or power-operated horn audible at least ½ mile.
26 ft. to less than 40 ft.	One hand or power-operated horn audible at least 1 mile.
40 ft. to 65 ft.	One power-operated horn audible for at least 1 mile.

Bells:

Although the "Rules of the Road" require all vessels to sound proper signals, only motorboats 26 feet and greater in length are *required* to carry bells. Where required, bells must be in serviceable condition, and if not permanently mounted, they must be readily accessible. The minimum requirements are:

Boat Length	*Requirement*
26 ft. to 65 ft.	One bell, which when struck, produces a bell-like tone of full round characteristics.

Running Lights - Inland and International

All vessels shall show required running lights between sunset and sunrise and during periods of restricted visibility. The following shows the inland and international light requirements for boats less than 20 meters (65 ft. 8 in.). In many cases, the lights prescribed for a particular vessel are the same under both rules. Any exceptions are noted. A sailboat operating under power or under power and sail must display the proper lights for a powerboat.

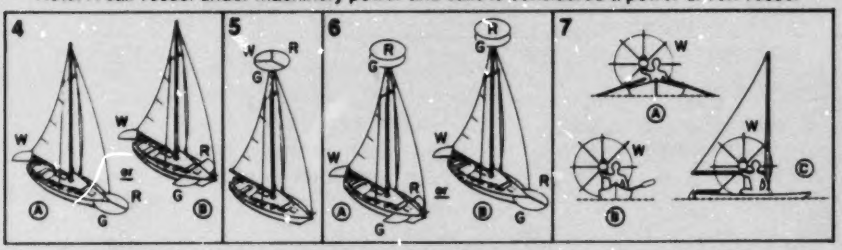
Color Code W=White R=Red G=Green

POWER-DRIVEN VESSELS

In inland and international waters, a power-driven vessel shall exhibit navigation lights as shown in 1 and 2. Vessels less than 12 meters (39 ft. 5 in.) in international and inland waters may, in addition to the lights depicted in 1 or 2, use those lights shown in 3. In international waters a power-driven vessel of less than 7 meters (22 ft. 9 in.) in length and whose maximum speed cannot exceed 7 knots may, in lieu of the lights prescribed in 1 and 2, exhibit an all-round white light. Such vessel shall, if practicable, also exhibit side lights.

SAILING VESSELS AND VESSELS UNDER OAR

Note: A sail vessel under machinery power and sails is considered a power-driven vessel



In inland and international waters sailing vessels *under sail alone* shall exhibit navigation lights shown in 4, 5 or 6. The tri-colored lantern shown in 5 and the all-round green and red lights shown in 6 should never be used together.

A sailing vessel of less than 7 meters (22 ft. 9 in.) in length shall: (a) if practicable, exhibit those lights prescribed in 4, 5 or 6 or (b) have ready at hand an electric torch or lighted lantern showing a white light which shall be exhibited in sufficient time to prevent collision (see 7c).

A vessel under oars may: a) display those lights prescribed for sailing vessels or b) have ready at hand an electric torch or lighted lantern showing a white light which shall be exhibited in sufficient time to prevent collision (see 7).

Range and Degree of Visibility of Lights

Locations	Visible Range		Degrees
	Vessel less than 12 meters	Vessel 12 meters or more but less than 20 meters	
Masthead Light	2 Miles	3 Miles	225°
All-round Light	2 Miles	2 Miles	360°
Side Lights	1 Mile	2 Miles	112.5°
Stern Light	2 Miles	2 Miles	135°

Anchor Lights:

Power-driven vessels and sailing vessels at anchor must display anchor lights. Exceptions are: (a) vessels less than 7 meters (22 ft. 9 in.) in length are not required to display anchor lights unless anchored in or near a narrow channel, fairway or anchorage, or where other vessels normally navigate and (b) vessels in inland waters when at anchor in a special anchorage area designated by the Secretary of Transportation are not required to exhibit an anchor light.

An anchor light is a white light exhibited forward where it can best be seen and is visible for 2 miles.

Marine Sanitation Devices:

State and local laws relating to marine sanitation devices have been preempted by federal regulations and equipment standards established jointly by the Environmental Protection Agency and Coast Guard. For more information on this subject, please write to the Department of Boating and Waterways for a pamphlet on marine sanitation devices and a list of those coastal harbors whose waters have been declared as "no discharge" areas.

Visual Distress Signals:

Vessels operating on coastal waters must carry the required number of approved visual distress signalling devices selected from the chart shown below.

Coastal waters include: (a) territorial seas and bays and sounds which empty into these waters and (b) rivers from the headlands up to the first point where the width of the river narrows to less than two miles. This includes all saltwater bays, harbors and marinas along the coast. In San Pablo Bay the regulations extend eastward to the Carquinez Bridge. The carriage requirements are:

1. All boats 16 feet or greater in length must carry devices aboard *at all times*. Boaters must carry: (a) either devices that are suitable for day use and devices suitable for night use *OR* (b) devices that can be used for both day and night use.

2. Boats less than 16 feet; manually propelled craft of any size; sailboats under 26 feet of completely open construction and not equipped with propulsion machinery; and boats competing in any organized marine parade, regatta, race or similar event are only required between *sunset and sunrise* to carry aboard devices that are *suitable for night use.*

All visual distress signalling devices must be Coast Guard approved, be readily accessible and in serviceable condition.

VISUAL DISTRESS REQUIREMENTS

Boaters may select a group or any combination as long as it meets the specific requirement for their boat.

Number on Device	Device Description	Accepted use for	Number Required to be carried
160.021	Hand red flare, distress signals	Day and night[1]	3
160.022	Floating orange smoke distress signals	Day only	3
160.024	Pistol-projected parachute red flare distress signals	Day and night[2]	3
160.036	Hand-held rocket-propelled parachute red flare distress signals	Day and night	3
160.037	Hand-held orange smoke distress signals	Day only	3
160.057	Floating orange smoke distress signals	Day only	3
160.066	Distress signal for boats, red aerial pyrotechnic flare	Day and night[3]	3
160.072	Distress signal for boats, orange flag	Day only	1
161.013	Electric distress light for boats	Night only	1

[1]These signals must have a date of manufacture of October 1, 1980 or later to be acceptable.
[2]These signals require use in combination with a suitable launching device approved under 46 CFR 160.028.
[3]These devices may be either self-contained or pistol launched, and either meteor or parachute assisted type. Some of these signals may require use in combination with a suitable launching device approved under 46 CFR 160.028.

SIGNALS TO ATTRACT ATTENTION

If necessary to attract the attention of another boat, the boater may: (a) make light or sound signals that cannot be mistaken for any signal authorized under the rules of the road or any recognized distress signal or (b) direct a searchlight in the direction of the danger, in such a way as not to embarrass any other vessel.

RECKLESS OR NEGLIGENT OPERATION

No person shall operate any vessel or manipulate any water skis, aquaplane or similar device in a reckless or negligent manner so as to endanger the life, limb or property of any person. Examples of such operation include, but are not limited to:

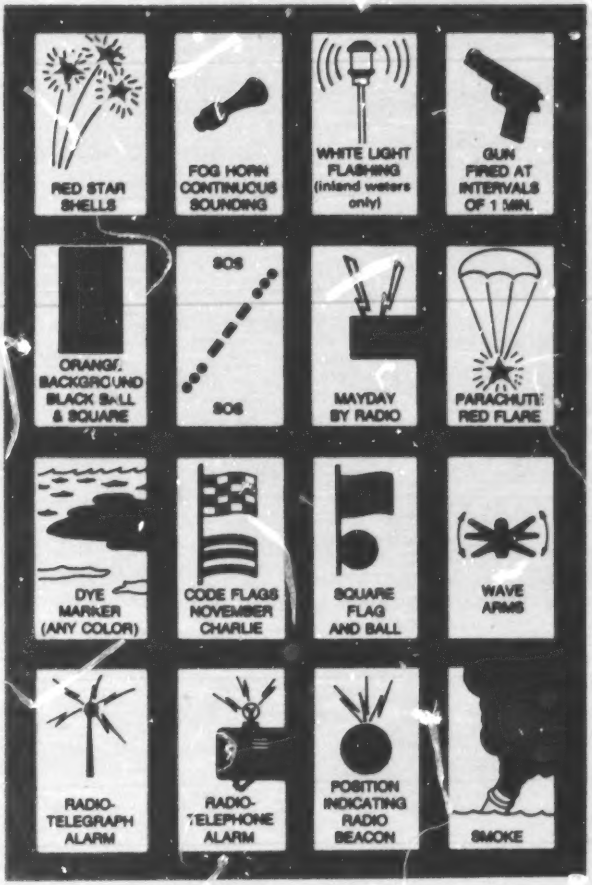
1. Riding on the bow, gunwale or transom of a vessel propelled by machinery underway when such position is not protected by railing or other reasonable deterrent to falling overboard or riding in a position or manner which is obviously dangerous. (These provisions shall not apply to a vessel's crew in the act of anchoring, mooring, or making fast to a dock or another vessel or the necessary management of a sail.)

2. Maneuvering towed skiers, or other devices, so as to pass the towline over another vessel or its skier.

3. Navigating a vessel, skis or other devices between a towing vessel and its tow or tows.

RECOGNIZED DISTRESS SIGNALS

The following are some of the signals that are recognized as indicating distress and need of assistance. On coastal waters, recognized distress signals are in addition to the required visual distress signals (see page 11).



4. Operating under the influence of intoxicants or narcotics.

Other actions such as speeding in confined or restricted areas, "buzzing" or "wetting down" others, or skiing at prohibited times or in restricted areas can also be construed to be reckless or negligent operation.

SPEED

Speed is limited by law for certain conditions and areas. The maximum speed for boats within 100 feet of a bather (but not water skier) and within 200 feet of a bathing beach, swimming float, diving platform or life line, passenger landing being used, or landing where boats are tied up is 5 miles per hour.

A safe speed should be maintained at all times so that: (a) action can be taken to avoid collision and (b) the boat can stop within a distance appropriate to the prevailing circumstances and conditions.

In restricted visibility, motorboats should have the engines ready for immediate maneuvering.

BOATING AND ALCOHOL

Alcohol plays a significant role in serious boating accidents and fatalities. It is unlawful to operate a boat while under the influence of alcohol or certain drugs. In addition, it is a felony to cause death or serious injury to another person while operating a boat under the influence.

ACCIDENTS

Operators Involved in a Boating Accident Shall:

1. Give assistance to other persons involved.
2. Give their name, address, and identification of their boat in writing to any person injured or to the owner of any property damaged in the accident.
3. When a person dies or disappears from a vessel, the operator shall by the quickest means available notify the Department of Boating and Waterways and the nearest enforcement agency having jurisdiction over the waterbody.

Boat Operators or Owners Must Make a Written Report of a Boating Accident to the Department of Boating and Waterways When:

1. A person dies, disappears or is injured and requires medical treatment beyond first aid.
2. There is property damage of more than $200 or there is complete loss of the vessel.

This report must be made within 48 hours of the accident in cases involving a disappearance, death that occurs within 24 hours of the accident or injury that requires medical treatment beyond first aid. In all other incidents where a written accident report is required, the report must be made within 10 days of the accident.

An accident report form is contained in this booklet and may be used for such reports. Forms are available through sheriff, police and harbormaster offices and may also be obtained by writing to the Department of Boating and Waterways. Failure to comply with the above requirements is punishable by a fine up to $500, imprisonment up to 6 months or both.

15

ACCIDENT DATA

44. OPERATION AT TIME OF ACCIDENT?
(CHECK ALL APPLICABLE)

- ☐ CRUISING
- ☐ MANEUVERING
- ☐ WATER SKIING
- ☐ TOWING
- ☐ DRIFTING
- ☐ AT ANCHOR
- ☐ TIED TO DOCK
- ☐ OTHER (USE ITEM 49)

45. TYPE OF ACCIDENT

- ☐ GROUNDING
- ☐ CAPSIZING
- ☐ FLOODING
- ☐ SINKING
- ☐ FIRE OR EXPLOSION (FUEL)
- ☐ FIRE OR EXPLOSION (OTHER THAN FUEL)
- ☐ VESSEL(S) COLLISION
- ☐ COLLISION WITH FIXED OBJECT
- ☐ COLLISION WITH FLOATING OBJECT
- ☐ FALL OVERBOARD
- ☐ FALL IN BOAT
- ☐ PERSON(S) HIT BY BOAT OR PROPELLER
- ☐ OTHER (USE ITEM 49)

46. IN YOUR OPINION, CAUSE OF ACCIDENT

- ☐ WEATHER CONDITIONS
- ☐ EXCESSIVE SPEED
- ☐ NO PROPER LOOKOUT
- ☐ OVERLOADING
- ☐ IMPROPER LOADING
- ☐ HAZARDOUS WATERS
- ☐ RESTRICTED VISION
- ☐ FAULT OF HULL
- ☐ FAULT OF MACHINERY
- ☐ FAULT OF EQUIPMENT
- ☐ OTHER (SPECIFY)

47. PERSONAL FLOTATION DEVICES (PFD)

WAS THE BOAT ADEQUATELY EQUIPPED WITH COAST GUARD APPROVED PERSONAL FLOTATION DEVICES? ☐ YES ☐ NO

WERE THEY ACCESSIBLE?	☐ YES	☐ NO
WERE THEY USED?	☐ YES	☐ NO

WAS THE VESSEL CARRYING NONAPPROVED

LIFESAVING DEVICES?	☐ YES	☐ NO
WERE THEY ACCESSIBLE?	☐ YES	☐ NO
WERE THEY USED?	☐ YES	☐ NO

48. FIRE EXTINGUISHERS

WAS APPROVED TYPE FIRE FIGHTING EQUIPMENT ABOARD? ☐ YES ☐ NO

WERE THEY USED? (IF "YES", LIST TYPE(S) AND NUMBER) ☐ YES ☐ NO

49. ACCIDENT DESCRIPTION

DESCRIBE WHAT HAPPENED AND WHAT COULD HAVE PREVENTED THIS ACCIDENT. (INCLUDE FAILURE OF EQUIPMENT. EXPLAIN CAUSE OF DEATH OR INJURY, MEDICAL TREATMENT, ETC. USE SKETCH IF HELPFUL. IF NEEDED, CONTINUE DESCRIPTION ON ADDITIONAL PAPER.)

113

BEST COPY AVAILABLE

IMPORTANT—It is mandatory that all items be completed when the information is available.

CALIFORNIA BOATING ACCIDENT REPORT

THE OPERATOR OF EVERY UNINSPECTED VESSEL[1] IS REQUIRED BY SECTION 656 OF THE HARBORS AND NAVIGATION CODE TO FILE A WRITTEN REPORT WHENEVER A BOATING ACCIDENT OCCURS WHICH RESULTS IN DEATH, DISAPPEARANCE, INJURY THAT REQUIRES MEDICAL TREATMENT BEYOND FIRST AID, TOTAL PROPERTY DAMAGE IN EXCESS OF $200, OR COMPLETE LOSS OF A VESSEL. REPORTS MUST BE SUBMITTED WITHIN FORTY-EIGHT (48) HOURS IN CASE OF DEATH OCCURRING WITHIN 24 HOURS OF THE ACCIDENT, DISAPPEARANCE, OR INJURY THAT REQUIRES MEDICAL TREATMENT BEYOND FIRST AID. ALL OTHER REPORTABLE ACCIDENTS MUST BE SUBMITTED IN WRITING WITHIN TEN (10) DAYS. REPORTS ARE TO BE SUBMITTED TO THE DEPARTMENT OF BOATING AND WATERWAYS, 1629 S STREET, SACRAMENTO, CALIFORNIA 95814, (916) 445-2437. FAILURE TO SUBMIT THIS REPORT AS REQUIRED IS A MISDEMEANOR AND IS PUNISHABLE BY A FINE NOT TO EXCEED FIVE HUNDRED DOLLARS ($500) OR IMPRISONMENT NOT TO EXCEED SIX (6) MONTHS OR BOTH.

COMPLETE ALL BLOCKS (PRINT OR TYPE ALL INFORMATION. INDICATE THOSE NOT APPLICABLE BY "N.A." THOSE UNKNOWN BY "UN."

1. OPERATOR'S NAME AND ADDRESS

TELEPHONE NUMBER

2. AGE

3. RENTED BOAT
- ☐ YES
- ☐ NO

4. OPERATOR'S EXPERIENCE

THIS TYPE OF BOAT	OTHER BOAT OPERATING EXPERIENCE
☐ UNDER 20 HOURS	☐ UNDER 20 HOURS
☐ 20 TO 100 HOURS	☐ 20 TO 100 HOURS
☐ 100 TO 500 HOURS	☐ 100 TO 500 HOURS
☐ OVER 500 HOURS	☐ OVER 500 HOURS

5. OWNER'S NAME AND ADDRESS

TELEPHONE NUMBER

6. NUMBER OF PERSONS ON BOARD

7. NUMBER OF PERSONS TOWED

8. FORMAL INSTRUCTION IN BOATING SAFETY
- ☐ NONE
- ☐ AMERICAN REDCROSS
- ☐ USCG AUXILIARY
- ☐ STATE
- ☐ US POWER SQUADRON
- ☐ OTHER (SPECIFY)

VESSEL NO. 1 (YOUR VESSEL)

9. BOAT NUMBER	10. BOAT NAME	11. BOAT MANUFACTURER	12. BOAT MODEL	13. MFGR. HULL IDENT. NO.

14. TYPE OF BOAT
- ☐ OPEN MOTORBOAT
- ☐ CABIN MOTORBOAT
- ☐ AUXILIARY SAIL
- ☐ SAIL ONLY
- ☐ HOUSEBOAT
- ☐ RAFT
- ☐ CANOE
- ☐ KAYAK
- ☐ OTHER (SPECIFY)

15. HULL MATERIAL
- ☐ WOOD
- ☐ ALUMINUM
- ☐ STEEL
- ☐ FIBERGLASS (PLASTIC)
- ☐ OTHER (SPECIFY)

16. PROPULSION
- ☐ OUTBOARD
- ☐ INBOARD
- ☐ INBOARD-OUTBOARD
- ☐ JET
- ☐ SAIL
- ☐ PADDLE
- ☐ OTHER (SPECIFY)

KIND OF FUEL

17. BOAT DATA

NUMBER OF ENGINES _____ LENGTH _____

MAKE OF ENGINE _____ BEAM (WIDTH) _____

HORSEPOWER (TOTAL) _____ DEPTH (TOP OF INNER TRANSOM TO KEEL) _____

YEAR BUILT (ENGINE) _____ YEAR BUILT (BOAT) _____

18. PRIMARY BOAT USE
- ☐ RECREATIONAL
- ☐ COMMERCIAL
- ☐ PUBLIC
- ☐ WORK BOAT

19. VESSEL REGISTRATION
- ☐ UNDOCUMENTED
- ☐ DOCUMENTED
- ☐ NUMBERED

VESSEL NO. 2 (OTHER VESSEL INVOLVED)

BEST COPY AVAILABLE

113A

20. BOAT NUMBER	21. BOAT TYPE	22. BOAT MANUFACTURER	23. BOAT MODEL	24. MFGR. HULL IDENT. NO.

25. NAME OF OPERATOR TELEPHONE NUMBER	26. ADDRESS
27. NAME OF OWNER TELEPHONE NUMBER	28. ADDRESS

29. WITNESSES

NAME	ADDRESS	TELEPHONE NUMBER
NAME	ADDRESS	TELEPHONE NUMBER
NAME	ADDRESS	TELEPHONE NUMBER

ACCIDENT DATE AND LOCATION

30. DATE OF ACCIDENT	31. TIME ____AM ____PM	32. NAME OF BODY OF WATER 33. LAST PORT OF CALL	34. LOCATION (AS PRECISELY AS POSSIBLE)
35. STATE	36. NEAREST CITY OR TOWN		37. COUNTY

ENVIRONMENTAL CONDITIONS

38. WEATHER	39. WATER CONDITIONS	40. TEMPERATURE	41. WIND	42. VISIBILITY	43. WEATHER ENCOUNTERED
☐ CLEAR ☐ RAIN ☐ CLOUDY ☐ SNOW ☐ FOG ☐ HAZY	☐ CALM ☐ CHOPPY ☐ ROUGH ☐ VERY ROUGH ☐ STRONG CURRENT	(ESTIMATE) AIR_____° F WATER_____° F	☐ NONE ☐ LIGHT (0 TO 6 MPH) ☐ MODERATE (7 TO 14 MPH) ☐ STRONG (15 TO 25 MPH) ☐ STORM (25 MPH AND OVER)	☐ GOOD ☐ FAIR ☐ POOR	☐ WAS AS FORECAST ☐ NOT AS FORECAST ☐ FORECAST NOT OBTAINED

* A VESSEL NOT REQUIRED TO HAVE A CERTIFICATE OF INSPECTION UNDER CHAPTER I OF TITLE 46, CODE OF FEDERAL REGULATIONS.

THIS CONFIDENTIAL REPORT IS USED IN RESEARCH FOR THE PREVENTION OF ACCIDENTS AND A COPY IS FORWARDED TO THE UNITED STATES COAST GUARD.

A-1 (REV. 4-80) ①◇ OMP (COMPLETE BOTH SIDES)

BEST COPY AVAILABLE

50. DECEASED

NAME	ADDRESS	DATE OF BIRTH	VICTIM WAS—	CAUSE OF DEATH
			☐ SWIMMER ☐ NON-SWIMMER	☐ DROWNING ☐ DISAPPEARANCE ☐ OTHER (SEE ITEM 49)
			☐ SWIMMER ☐ NON-SWIMMER	☐ DROWNING ☐ DISAPPEARANCE ☐ OTHER (SEE ITEM 49)

51. INJURED (UNCONSCIOUS, GIVEN MEDICAL TREATMENT OR DISABLED OVER 24 HOURS)

NAME / TELEPHONE NUMBER	ADDRESS	DATE OF BIRTH	NATURE OF INJURY	
				☐ RECEIVED TREATMENT ☐ INCAPACITATED OVER 24 HOURS
				☐ RECEIVED TREATMENT ☐ INCAPACITATED OVER 24 HOURS

52. PROPERTY DAMAGE (ESTIMATE AND DESCRIBE)

THIS BOAT $_____

TOTALLY DESTROYED ☐ YES ☐ NO OTHER BOAT $_____ OTHER PROPERTY $_____

53. DAMAGED PROPERTY OWNER'S NAME AND ADDRESS

54. PERSON COMPLETING REPORT

SIGNATURE OF PERSON COMPLETING REPORT	ADDRESS	DATE SUBMITTED
QUALIFICATION (CHECK ONE) ☐ OPERATOR ☐ OWNER ☐ OTHER (SPECIFY)		TELEPHONE NUMBER

DID YOU SIGN AND DATE THIS REPORT? *(See Section 54)*

BEST COPY AVAILABLE

INLAND NAVIGATION RULES ACT

Although the Inland Navigation Rules Act was adopted in 1980 and went into effect December 24, 1981, it caught many recreational boaters by surprise. The information on this page was developed as a handy reference to the pertinent changes in the new inland rules of the road. (This is not intended to be a condensed version of the complete act.)

First, a boat will not have to be rebuilt to conform to the new regulations. All currently required equipment is still valid and all vessels under 20 meters (65 ft. 8 in.) are exempt from the light configuration changes.

Secondly, there is no need to be concerned about having to learn a whole new set of rules. Many of the changes rearrange the old rules to correspond with the format of the 1972 International Regulations for Preventing Collisions at Sea, commonly referred to as the COLREGS. (All public and private vessels of the United States must adhere to the COLREGS while navigating on the high seas.)

Changes that boaters should become familiar with are:

GENERAL

1. All measurements used are metric. In the "ABC'S," the corresponding measurement in feet and inches are given.

2. General Prudential Rule and Rule of Good Seamanship have been combined, now referred to as "Responsibility Rule."

STEERING AND SAILING

1. PRIVILEGED vessel now referred to as STAND-ON vessel.

2. BURDENED vessel now referred to as GIVE-WAY vessel.

3. Definition of safe speed is broader in scope than in the old rules. Boats must operate at a safe speed at all times, not just under conditions of restricted visibility.

4. Steering and sailing rule for *sailing vessels* in sight of one another has been changed to agree with international rules and deletes previous reference to sailing vessels running free.

LIGHTS AND SHAPES

1. Sailing vessels less than 20 meters (65 ft. 8 in.) may use a tri-colored light.

2. Sailing vessels (any length) may, in addition to normal running lights, use two all-round red and green lights near the top of the mast.

3. Arc of visibility will no longer be in points, but in degrees.

SOUND SIGNALS

1. Long blast is no longer used. The new bend/leaving a dock signal is a prolonged blast.

2. Danger/Doubt signal is now *five* or more short blasts.

3. Powerboats underway in reduced visibility must sound a fog signal every two minutes.

4. Fog signal for sailing vessels is one prolonged blast followed by two short blasts every two minutes, regardless of tack.

The text in this edition of the "ABC's" has been revised to reflect any changes in the new inland rules of the road. The "ABC's" does not include *all* the provisions of the Inland Navigational Rules Act.

INLAND RULES OF THE ROAD

The Inland Navigational Rules, commonly called the "Rules of the Road," govern the operation of boats and specify light and sound signals on inland waters in order to prevent collisions. This section includes the operator's general responsibilities under the rules of the road, the rules governing the conduct of watercraft, and the various navigation and fog signals. The rules of the road pertaining to lights, speed, and signals to attract attention or indicate distress are found in other sections of this booklet.

Responsibility:

Nothing in the rules of the road shall exonerate the operator of a vessel from the consequences of neglecting to comply with the rules or from neglecting any precaution which may be required by the ordinary practice of seamen, or by special circumstances.

In construing and complying with the rules of the road, due regard shall be had to all dangers of navigation and collision and to any special circumstances, including the limitations of the vessels involved, which may make a departure from these rules necessary to avoid immediate danger.

Navigation Signals:

The law prescribes signals to indicate the intended course of a vessel when necessary for safe navigation.

1. One short blast (one second) will show an intention to direct course of vessel to own starboard (right).
2. Two short blasts will show intention to direct course of vessel to own port (left).
3. Three short blasts will indicate the vessel's engines are going astern (in reverse).
4. Five or more short and rapid blasts of the horn or whistle is a danger signal used when the other vessel's intentions are not understood or where the other vessel's indicated course is dangerous.

Motorboats should not use cross signals, that is, answering one blast with two blasts or two blasts with one blast.

Meeting or Crossing Situations:

The rules direct motorboats in situations where there is a risk of collision that:

- When meeting *head-on,* or nearly so, either vessel shall signal its intention with one short blast which the other vessel shall answer promptly. Both vessels should alter their course to starboard (right) so that each will pass on the port (left) side of each other (see Figure 3).
- When crossing, the vessel which has the other on the starboard (right) side shall keep out of the way and avoid crossing ahead of the other vessel. The give-way vessel, the vessel directed to keep out of the way, shall take early and substantial action to keep well clear of the other vessel (stand-on vessel). This latter vessel should hold course and speed (see Figure 4). However, it may, as the stand-on vessel, take

action to avoid collision by maneuvering as soon as it becomes apparent that the vessel required to keep out of the way is not taking appropriate action.

When motorboats are in sight of one another and meeting or crossing at a distance within half a mile of each other, each vessel shall indicate its intended maneuver with the following signals: one short blast - I intend to leave you on my port side, two short blasts - I intend to leave you on my starboard side, or three short blasts - I am operating astern propulsion.

Upon hearing the one or two blast signal, the other vessel shall, if in agreement, sound the same signal and take steps to effect a safe passing. If the proposed maneuver is unsafe, the danger signal (five or more short and rapid blasts) should be sounded and each vessel shall take appropriate action until a safe passing agreement is made.

(Figure 3)

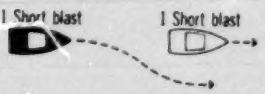
(Figure 4)

Overtaking Situations:

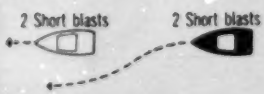
When two motorboats are running in the same direction and the vessel astern desires to pass, it shall give one short blast to indicate a desire to pass on the overtaken vessel's starboard. The vessel ahead shall answer with one blast if the course is safe (see Figure 5).

If the vessel astern desires to pass to port of the overtaken vessel, it shall give two short blasts. The vessel ahead shall answer with two short blasts if the course is safe (see Figure 6). If it is unsafe to pass, the vessel being overtaken should answer with the danger signal (five or more short and rapid blasts).

A vessel approaching another vessel from the stern and overtaking it shall keep out of the way of the overtaken vessel. The vessel being overtaken shall hold its course and speed.



(Figure 5)



Overtaking vessel

(Figure 6)

Other Situations:

A boat nearing a bend in a channel where vessels approaching from the other direction cannot be seen shall signal with a prolonged blast (four to six seconds), which shall be answered with the same signal by any approaching boat within hearing. Should such signal be answered by a boat on the farther side of the bend, then usual signals for meeting and passing shall be given upon sighting. If the signal is unanswered, the channel may be considered clear.

Boats shall keep to the starboard side of narrow channels whenever safe and practicable.

Motorboats leaving a dock or berth shall sound one prolonged blast.

Motorboats shall keep out of the way of sailing vessels where courses involve the risk of collision.

In narrow channels, boats under 65 feet 8 inches in length shall not hamper safe passage of vessels, such as deep draft liners and freighters, which can navigate only inside such channels.

Rules for Sailing Vessels:

When two sailing vessels are approaching one another, so as to involve risk of collision, one of them shall keep out of the way of the other as follows:

1. When each has the wind on a different side, the vessel which has the wind on the port side shall keep out of the way of the other.

2. When both have the wind on the same side, the vessel which is to windward shall keep out of the way of the vessel which is to leeward.

3. If a vessel with the wind on the port side sees a vessel to windward and cannot determine with certainty whether the other vessel has the wind on the port or on the starboard side, she shall keep out of the way of the other.

The windward side shall be deemed to be the side opposite to that on which the mainsail is carried or, in the case of a square-rigged vessel, the side opposite to that on which the largest fore-and-aft sail is carried.

The international rules for sailing are the same as the above.

Fog Signals:

The law also prescribes signals to identify vessels navigating in or near areas of restricted visibility.

Motorboats:

- Making way through the water, sound at intervals of not more than 2 minutes one prolonged blast.
- Underway but stopped and making no way through the water, sound at intervals of not more than 2 minutes two prolonged blasts in succession, with an interval of about two seconds between them.

Sailboats:

- Sound at intervals of not more than 2 minutes one prolonged followed by two short blasts.

Boats at Anchor:

- Ring at intervals of not more than one minute a bell rapidly for about five seconds. In addition, one short blast followed by one prolonged and one short blast *may* be sounded to give warning of position and of the possibility of collision to an approaching vessel.

- Boats less than 20 meters (65 ft. 8 in.) are not required to sound signals when anchored in a federally designated anchorage area.

Short Blast - 1 second Prolonged Blast - 4 to 6 seconds

Upon hearing a fog signal apparently forward of the beam, the operator should reduce speed to the minimum at which the boat can be kept on course, unless it has been determined by radar or other means that the risk of collision does *not* exist. If necessary the operator should back down the engines to kill way. In any event, navigate with extreme caution until any danger is over.

LAW ENFORCEMENT

Every peace officer of the state, city, county, harbor district or other political subdivision of the state is empowered to enforce the California Boating Law. Such officers have the authority to stop and board any vessel subject to the state boating law.

Peace officers are also authorized to order the operator of an unsafe vessel to shore. A vessel can be ordered to the nearest safe moorage if an unsafe condition is found that cannot be corrected on the spot and where, in the judgement of the officer, the continued operation of the vessel would be especially hazardous.

STOLEN VESSELS

If a numbered vessel is stolen, the owner or legal owner should notify the local law enforcement agency as soon as possible. The owner should also notify the local law enforcement agency if the vessel reported stolen is recovered.

COUNTY AND CITY LAWS

In addition to the state law, many counties, cities and districts have special laws or ordinances which restrict activities in certain areas and at certain times, prohibit certain acts or establish additional requirements. These ordinances may regulate speed, set aside certain areas or hours for special purposes and prohibit acts which would be contrary to public interest. Boaters must comply with these local rules as well as with the state laws.

WATER SKIING

When using a boat to tow a person on water skis or an aquaplane, there must be in the boat, in addition to the operator, one other person who can observe the person being towed. The observer must be at least 12 years of age.

The towing of water skiers from sunset to sunrise is prohibited. Where there are local laws establishing special hours for these sports, this rule will not apply; nor will it apply where professional exhibits, regattas, races or parades are authorized.

Water skis and aquaplanes will not be operated in a manner to endanger the safety of persons or property. Passing the towline over another vessel or skier or navigating between a vessel and its tow is prohibited. Towing a skier does not give the operator of the vessel any special privileges. The rules of the road must be observed.

Skiers being towed are considered to be persons onboard for personal flotation device requirements. For more information on water skiing, send for the free pamphlet titled "Safety Hints for Water Skiing" from the Department of Boating and Waterways. (See centerfold card).

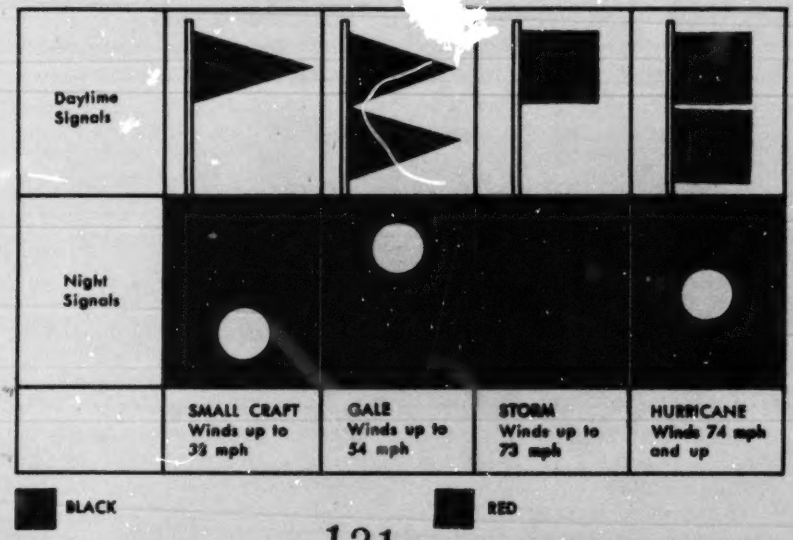
While the California Boating Law *does not require* the use of a ski flag, it does recognize that exhibiting a *red* flag indicates:

- A downed skier.
- A skier getting ready to ski.
- A ski, line or similar equipment in the immediate area.

The display of the ski flag does not in itself restrict the use of the water, but when operating in the area, boaters should exercise precaution.

WEATHER ADVISORIES

At selected locations in and near boating areas, storm advisories are displayed by flag hoists or lights. Display points are usually Coast Guard stations, yacht marinas or municipal piers. A boater should become familiar with the display stations in the area and the meanings of the signals.



AIDS TO NAVIGATION

Lateral System (Federal):

The waters of the United States are marked for safe navigation by the lateral system of buoyage. This system employs a simple arrangement of colors, shapes, numbers and light characteristics to show the side on which a buoy should be passed when proceeding in a given direction. The characteristics are determined by the position of the buoy with respect to the navigable channels as the channels are entered from seaward.

The expression "red right returning" has long been used by the seafarer as a reminder that the red buoys are passed on the starboard side when proceeding from the open sea into port (upstream). Likewise, black or green buoys are left to port (see following page). Conversely, when proceeding toward the sea or leaving port, red buoys are left to port and black or green buoys to starboard. Red buoys are always even-numbered. Black or green buoys are odd-numbered.

Uniform State Waterway Marking System:

Many bodies of water used by boaters are located entirely within the boundaries of the state. The Uniform State Waterway Marking System has been devised for these waters and is in use in California.

The waterway marking system employs buoys and signs with distinctive standard shapes to show regulatory or advisory information. These markers are white with black letters and have orange borders. They signify speed zones, restricted areas, danger areas and general information.

Aids to navigation on state waters use red and black buoys to mark channel limits. Red and black buoys are generally used in pairs. The boat should pass between the red buoy and its companion black buoy. Examples of such aids are found on the back cover of this booklet.

Aids to Navigation Changes:

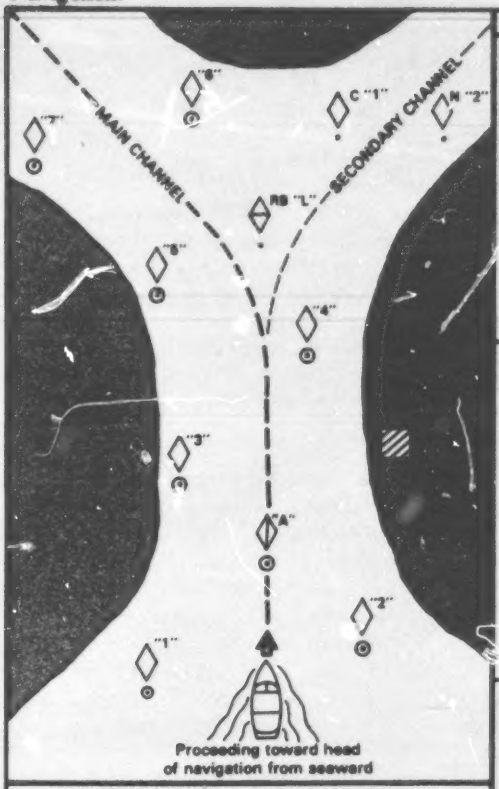
Modifications have begun on certain aids to navigation located on coastal and inland waters. These changes apply to aids used in the lateral system. The modifications are being phased in over a six-year period as the buoys are brought in for routine maintenance. The changeover is expected to be completed in 1989. The most noticeable changes will be:

- Port hand buoys (presently painted black) will be painted green.
- Midchannel, fairway and approach buoys (presently painted with black and white vertical stripes) will be painted with red and white vertical stripes.
- Junction buoys (presently painted with red and black horizontal bands) will be painted with red and green horizontal bands. The light characteristic will be Composite Group Flashing (2+1).
- All other buoy categories (traffic separation, anchorage areas, dredging, fish net area, etc.) will be painted yellow.

Isolated danger markers—aids with black and one or more horizontal red bands—are being introduced into the navigational aid system. They will seldom be used and only after junction buoys are changed to green.

FEDERAL CHANNEL MARKING SYSTEM

The diagram below, uses typical chart symbols to show the course a boat will take following the lateral system of buoyage. For more information on the lateral system and the various modifications being made, refer to the section in this booklet titled "Aids to Navigation."

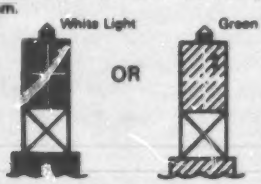


MAIN CHANNEL BUOYS

"1" "3" "5" "7"

LIGHTED BUOY (Port Hand)

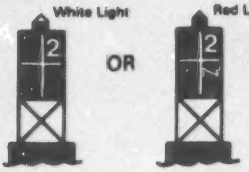
Odd number, increasing toward head of navigation. Leave to port (left) proceeding upstream.



"2" "4" "6"

LIGHTED BUOY (Starboard Hand)

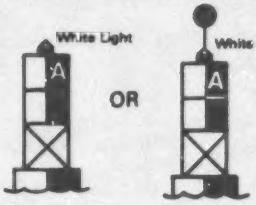
Even number, increasing toward head of navigation. Leave to starboard (right) proceeding upstream.



"A"

LIGHTED SAFE WATER BUOY

No number. Marks midchannel, pass on either side. Letter has no lateral significance, used for identification and location purposes.

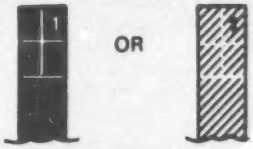


SECONDARY CHANNEL BUOYS
STARTS NEW NUMBERING SYSTEM

C "1"

CAN BUOY

Odd number. Leave to port.



"2"

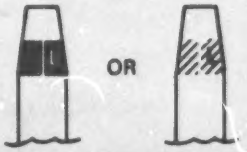
NUN BUOY

Even number. Leave to starboard.

RB "L"

PREFERRED CHANNEL BUOY

No number. Topmost band red (RB-red/black) — preferred channel is to left of buoy. Letter has no lateral significance, used for identification and location purposes.



BEST COPY AVAILABLE

Items E = essential D = desirable	Less than 16 ft.			16 ft. to under 26 ft.			26 ft. to under 40 ft.			40 ft. to 65 ft.		
	Open waters	Semi-protected	Protected	Open waters	Semi-protected	Protected	Open waters	Semi-protected	Protected	Open waters	Semi-protected	Protected
Anchor, cable (line, chain, etc.)	E	E	E	E	E	E	E	E	E	E	E	E
Bailing device (pump, etc.)	E	E	E	E	E	E	E	E	E	E	E	E
Boat hook	..	..	..	D	D	D	E	E	E	E	E	E
Bucket (fire fighting/ bailing)	E	E	E	E	E	E	E	E	E	E	E	E
Compass	E	E	D	E	E	D	E	E	E	E	E	E
Distress signals	E	E	E	E	E	E	E	E	E	E	E	E
Emergency drinking water	E	D	..	E	D	..	E	D	..	E	D	..
Fenders	D	D	D	D	D	D	D	D	D	D	D	D
First-aid kit and manual (10- to 20-unit)	E	E	E	E	E	E	E	E	E	E	E	E
Flashlight	E	E	E	E	E	E	E	E	E	E	E	E
Heaving line	..	..	..	..	..	..	D	D	D	D	D	D
Light list	D	D	..	E	E	D	E	E	E	E	E	E
Local chart(s)	E	D	..	E	E	E	E	E	E	E	E	E
Mirror (for signaling)	D	D	..	D	D	..	D	D	..	D	D	..
Mooring lines	E	E	E	E	E	E	E	E	E	E	E	E
Motor oil and grease (extra supply)	..	..	..	D	D	D	D	D	D	D	D	D
Oars, spare	E	E	E	E	E	E	..	..	..	..	..	..
Radio direction finder	..	..	..	D	..	..	D	..	..	D	..	..
Radio, telephone	D	..	..	D	D	..	D	D	..	D	D	..
Ring buoy(s) (additional)	D	D	D	D	D	D	D	D	D	D	D	D
Shear pins (if used)	E	E	D	E	E	D	..	..	..	..	..	..
Depth sounding device, (lead line, etc.)	D	D	..	D	D	D	E	E	E	E	E	E
Spare batteries	D	D	D	D	D	D	D	D	D	D	D	D
Spare parts	E	D	..	E	E	D	E	E	D	E	E	D
Tables, current	..	..	..	..	..	..	..	D	D	..	E	E
Tables, tide	..	..	D	..	..	D	..	D	D	..	E	E
Tools	E	D	..	E	E	D	E	E	D	E	E	D

RADIO PROCEDURES

MARINE EMERGENCY AND DISTRESS

Speak Slowly and Clearly

Call:

1. If you are in Distress (i.e. when threatened by grave and imminent danger) transmit the International Distress Call on Chan. 16 " MAYDAY MAYDAY MAYDAY THIS IS (Your vessel's call and name repeated THREE times)"*

2. If you need INFORMATION OR ASSISTANCE FROM THE COAST GUARD (other than in a distress), call COAST GUARD on Chan. 16 (The Distress and Calling Frequencies). In this situation you will normally be shifted to a common working frequency (Chan. 22A) allowing the DISTRESS frequency to remain open.

*The Radiotelephone Alarm Signal (if available) should be transmitted prior to the Distress Call for approximately one minute. The Radiotelephone Alarm Signal consists of two audio tones, of different pitch, transmitted alternately. Its purpose is to attract the attention of persons on watch and shall only be used to announce that a distress call or message is about to follow.

IF ABOARD A VESSEL IN TROUBLE — state:

1. WHO you are (your vessel's call and name).
2. WHERE you are (your vessel's position in latitude/longitude or true bearing and distance in nautical miles from a widely known geographical point; local names known only in the immediate vicinity are confusing).
3. IF you require Coast Guard assistance and whether or not you are in immediate danger.
4. WHAT is wrong (nature of distress or difficulty, if not in distress).
5. Kind if assistance desired.
6. Number of persons aboard and the condition of any injured.
7. Present seaworthiness of your vessel.
8. Description of your vessel — length, type, cabin, masts, power, color of hull, superstructure and trim.
9. Your listening frequency and schedule.

IF OBSERVING ANOTHER VESSEL IN DIFFICULTY — give:

1. Your position and (if possible) the bearing and distance of the vessel in difficulty.
2. Nature of distress or difficulty.
3. Description of the vessel in distress or difficulty (see item 7 above).
4. Your intentions, course, and speed, etc.
5. Your radio call sign, name of your vessel, listening frequency and schedule.

NOTE: The international signal for an aircraft that wants to direct a surface craft to a distress is:

Circling the surface craft, opening and closing the throttle or changing propeller pitch (noticeable by change in sound) while crossing ahead of the surface craft, and proceeding in the direction of the distress. If you receive such a signal, you should follow the aircraft. If you cannot do so, try to inform the aircraft by any available means. If your assistance is no longer needed, the aircraft will cross your wake opening and closing the throttle or changing the propeller pitch. If you are radio equipped, you should attempt to communicate with the aircraft on 2182 kHz or 156.8 MHz when the aircraft makes the above signals or makes any obvious attempt to attract your attention. In the event you cannot communicate by radio, be alert for a message block dropped from the aircraft.

NOTIFY THE COAST GUARD PROMPTLY AS SOON AS THE EMERGENCY TERMINATES

FLOAT PLAN

Before Embarking on a Cruise:

1. File a float plan (see reverse side)
2. Give consideration to basic safety items, including the following:

   Vessel in good condition

   Vessel properly loaded

   Ample supply of fuel

   Weather suitable

   Compass and charts

   Good anchoring equipment

   Bailing device

   Spare parts

   Tools

   Extra starting battery

   Flashlight

   Personal flotation devices (Coast Guard approved)

   Fire extinguishers (Coast Guard approved)

   Oars or paddles

Cancel your "Float Plan" when you return.

over

↓ Cut Out Page Along This Line ↓

FLOAT PLAN

of _____ _____

Name and address of boat operator — Phone number

Search for an overdue boat has a much greater chance of being successful if the Coast Guard or other rescue agencies have certain facts. For your own safety and before leaving on a cruise, complete this form and leave it with a reliable person who will notify authorities if necessary.

IF OVERDUE, CONTACT _____

Name and phone number of rescue agency near point of departure.

VESSEL Name_____ CF_____ Length_____ Type/Style_____

Power_____ Rig_____ Hull Color_____ Range_____ Speed_____

Inboard — Outboard (if sail)

PERSONS _____ **RADIO** _____

Number aboard Frequencies

DEPARTURE FROM_____ Date/Time Depart_____

DESTINATION_____ Stops Enroute_____ Date/Time Return_____

IMPORTANT: DON'T FORGET TO CANCEL FLOAT PLAN WHEN YOU RETURN

GLOSSARY

ABAFT. Aft of, or to rear of.

AMIDSHIPS. Center of vessel with reference to its length and/or sometimes its width.

AFT. Toward the stern of a vessel.

ASTERN. Behind a vessel, in a backward direction, or toward the stern.

BEAM. The vessel's maximum width.

BILGE. Lower internal part of a vessel's hull.

BOW. Forward part of a vessel.

CLOSEHAULED. Set of sail roughly parallel to keel of vessel when sailing into the wind.

DOCUMENTED VESSEL. Vessel registered with the United States Coast Guard.

FREEBOARD. Height of vessel's side measured from waterline to deck or gunwale.

GUNWALE. Top, outer, edge of vessel's hull.

HELMSMAN. One who steers a vessel.

HULL. Body of a vessel.

LEEWARD. On the side away from the wind.

POINT. (of compass) 11.25°. There are 32 points of the compass.

PORT. Side of vessel to the left when facing forward.

RUDDER. The device used for steering and maneuvering.

RUNNING. Act of vessel sailing with wind from behind.

STARBOARD. Side of vessel to right when facing forward.

STERN. After end of a vessel.

TACK–STARBOARD (PORT). Sailing with wind coming over the starboard (port) side.

TILLER. Bar or handle for turning a vessel's rudder.

UNDERWAY. Vessel in motion. Technically a vessel is underway when not moored, at anchor or aground.

WAY. Movement of a vessel through the water.

WINDWARD. Opposite of leeward, a direction from which wind is coming.

CALIFORNIA WATERWAY MARKER SYSTEM

BOATS KEEP OUT

EXPLANATIONS MAY BE PLACED OUTSIDE THE CROSSED DIAMOND SHAPE SUCH AS DAM, RAPIDS, SWIM AREA

DANGER

THE NATURE OF DANGER MAY BE INDICATED BY WORDS INSIDE THE DIAMOND SHAPE SUCH AS SHOAL, REEF, WRECK, DAM

CONTROLLED AREA

TYPE OF CONTROL IS INDICATED WITHIN THE CIRCLE SUCH AS 5mph, NO ANCHORING

INFORMATION

FOR DISPLAYING OFFICIAL INFORMATION SUCH AS DIRECTIONS, DISTANCES, LOCATIONS

MARKER ON PILING

MARKER ON SPECIAL PURPOSE BUOY

FLAG IS RED STRIPE WHITE

THE DIVERS FLAG

WHITE BUOY WITH BLUE STRIPE

A MOORING BUOY

CHANNEL MARKERS ON STATE WATERWAYS

MARKS LEFT SIDE OF CHANNEL

MARKS CENTER OF CHANNEL

MARKS RIGHT SIDE OF CHANNEL

WHEN RETURNING FROM MAIN WATER BODY OR PROCEEDING UPSTREAM

FREE BOATING SAFETY CLASSES explaining required and recommended equipment for small boats and offering training in good seamanship are conducted throughout California by the U.S. Coast Guard Auxiliary, the U.S. Power Squadron and many Red Cross chapters. For information write Department of Boating and Waterways, 1629 S Street, Sacramento, California 95814-7291 or phone (916) 445-2615.

75879-461 150M OBP LDA

BEST COPY

For additional free copies of the *ABCs of the California Boating Law* (current edition), write to:

Department of Boating and Waterways
1619 S Street
Sacramento, CA 95814-7291
Telephone (916) 445-2616

END

DEPT. OF EDUCATION

NAT'L INSTITUTE OF EDUCATION

ERIC

DATE FILMED

SEPTEMBER

4 - 1985